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April 12, 1934

APR 1934

Engineering News-Record

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New Orleans Builds An Elaborate Airport On the Shores of Lake Pontchartrain

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Continuous Beam Design
Technical Hazards of the Job
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In the News:

BUILDING MODERNIZATION and repair are being considered as part of the program for stimulating the capital-goods industries. A proposed bill includes private financing but federal guarantee of credit risk.

SPRING DISASTERS are again in the news, mostly as a result of floods. Some fifteen persons were drowned in Oklahoma after heavy rains swelled the Washita River to flood stage. In Wisconsin 10 to 15 dams under heads up to 25 ft. and more than 20 state highway bridges were seriously damaged or destroyed in the general vicinity of Hudson, Menomonie and Chippewa Falls. In Canada ice jams on the Grand and the St. Francis Rivers have caused flooding of low territory. Near West Point, N. Y., a landslide on the famous Storm King Highway wrecked two cars, killing three persons. And news dispatches from abroad told of fatalities and property damage from a huge wave in a Norway fjord caused by a great rock fall at the upper end of the valley.

RAPID PROGRESS is being made on the real property inventory being conducted with CWA funds by the Bureau of Foreign and Domestic Commerce in the Bureau of the Census. Of the questionnaires sent out in 65 cities, some 2,000,000 have been returned. An additional 500,000 are expected. All of the tabulation of the general schedule will have been completed by May 1, it is expected. Some preliminary data are already available.

BILLS SIGNED last week by Governor Lehman, New York, create two more "authorities" in New York City, which will construct parkways and charge tolls for their use—the Marine Parkway to connect Marine Park in Brooklyn with Jacob Riis Park in Queens by a causeway across Rockaway Inlet, the Henry Hudson Parkway to form an extension of Riverside Drive northward through Van Cortlandt Park.

CONTRACTORS forced to pay license fees to carry on work outside their home state must look elsewhere than to the U. S. Supreme Court for help, since the court has just refused to rule on the validity of a state license charged an Illinois contractor who is building a federal post office in Lynchburg, Va.

In This Issue:

MUCH INTEREST centers in the new airport at New Orleans, both as an air navigation terminal and as a notable piece of construction. Built on an artificial peninsula extending out into Lake Pontchartrain, the work involved includes construction of retaining walls in open water, unusual hydraulic-fill problems, a dual system of drainage and the construction of runways on partly stabilized fills using local materials.

DITCH EROSION is a phase of highway depreciation that has generally been considered more in theory than in practice. Georgia has used check dams successfully; observations based on its practices are presented.

THE DESIGN of indeterminate structures, in this country at least, is in a period of trial and selection. Methods correct enough theoretically may or may not be suitable for design-office use. Some years ago a graphical method of continuous-beam design based on the use of Maxwell's reciprocal theorem and the moment-area principle was described in these pages and met with some success in use. The author of that article now develops a comparable analytical method which offers further advantage.

TRANSFERRING STEEL SEATS from an old stadium to a new field house was the unusual type of CWA job carried out at the University of Iowa this winter. The seats, originally built in 1922, had practically a 100 per cent re-use value in 1934.

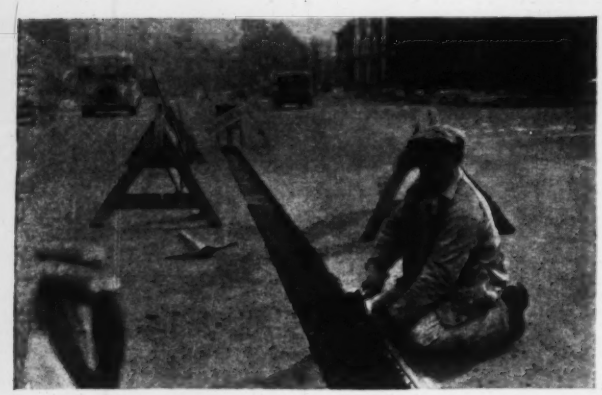
HISTORIC HOLYHEAD ROAD along the headlands of North Wales, built in part by Telford and paralleling Stephenson's Chester-Holyhead Railway, is being rebuilt. Situated on a precipitous hillside, it involves deep cuts, tunnels and high viaducts, as described by a British correspondent.

Coming Articles:

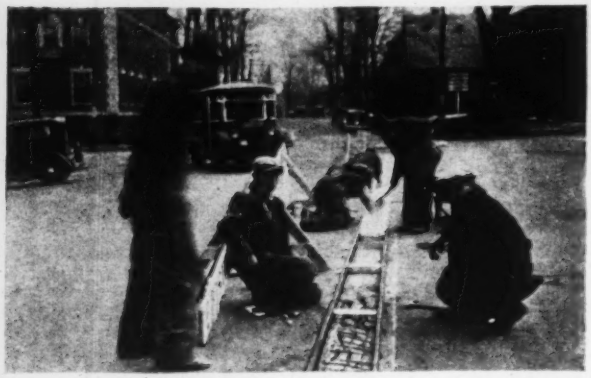
PROPER VENTILATION is one of the most important items in the successful driving of long tunnels. The ideal ventilation system is one furnishing sufficient pure air to guard the efficiency and health of the workmen, without excessive or wasteful cost of piping, compressors and power. How can such a plant be designed? The answer will be found in an article, to be published soon, describing methods used in planning the ventilation systems in use in nearly 200,000 ft. of tunnels on the Colorado River Aqueduct. With the aid of charts, formulas and tables presented therein, a contractor can lay out an economical yet adequate ventilation plant for any condition of tunneling.

WHITE CONCRETE TRAFFIC MARKERS ARE *EASY to BUILD*

1. In this asphalt-paved street in Middletown, Conn., for example, guide lines were marked on pavement and asphalt cut out in 12″ wide trench, down to concrete base.

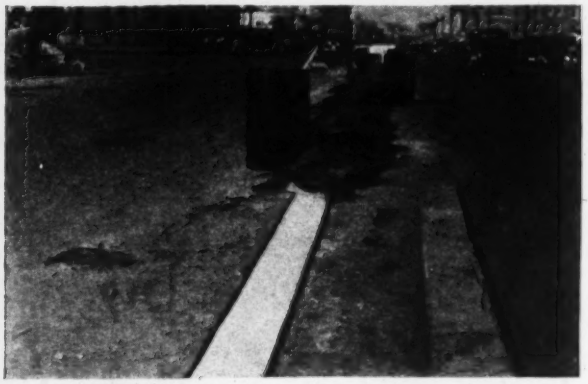


2. The next step was to undercut the edges of the trench, on both sides, to provide a mechanical bond between the asphalt and the marker. This was a simple job.

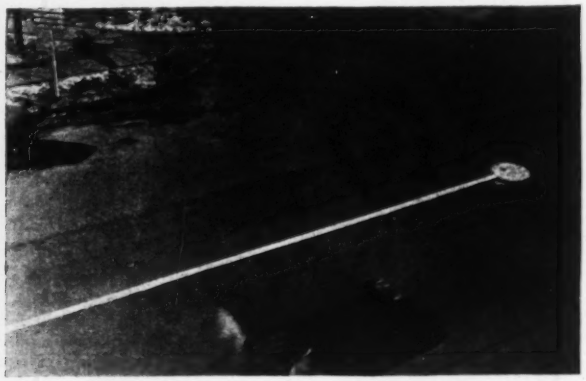


3. Then a layer of gray concrete was placed in the trench, and scratched to give a good bond. Before its initial set the one-inch topping of white concrete was placed.

4. Next the white concrete was troweled with a steel trowel to the smooth, hard, stain-resistant surface that will keep this white marker *permanently* white.



5. Finally the completed white concrete marker was covered with stainless paper and a layer of straw, to allow complete curing and to prevent freezing.



6. And here is the completed marker. It will guide traffic efficiently, for years, with *no replacement cost.* City Engineer Allen Schaefer built it with CWA labor. (Note—while CWA stops March 31, projects like this can be carried on under the Works Division of the Federal Emergency Relief Administration—FERA.) Write Universal Atlas Cement Co. (*Subsidiary of United States Steel Corporation*), 208 South La Salle Street, Chicago, for complete information.

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ATLAS WHITE TRAFFIC MARKERS

Made with Atlas White Portland Cement—Plain or Waterproofed

ENGINEERING NEWS-RECORD

New York

April 12, 1934

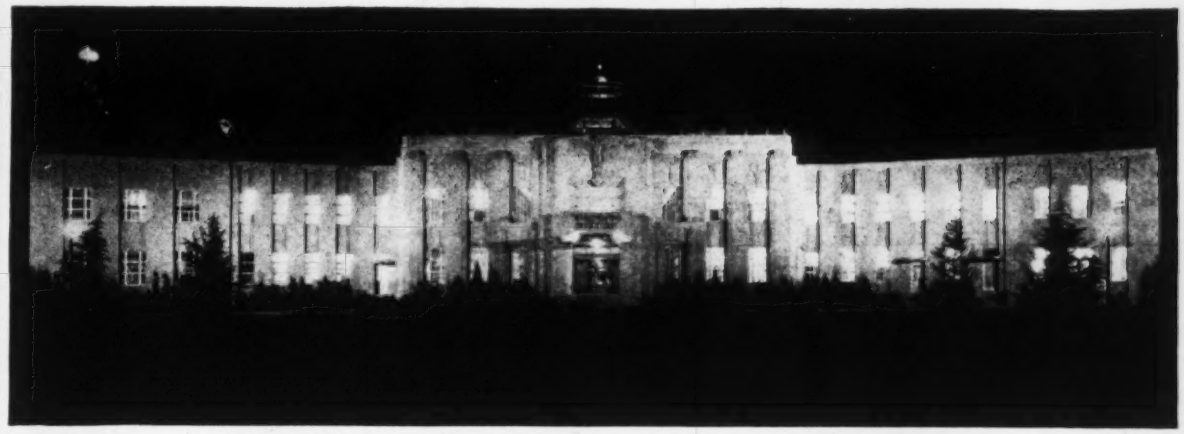


FIG. 1—THE BUILDINGS of the Shushan airport are illuminated at night as an aid to flyers as well as for artistic effect.

Large Airport for New Orleans Built on Fill in Lake Pontchartrain

By John Klorer

Chief Engineer, Orleans Levee Board
New Orleans, La.

EARLY in February a modern airport for the city of New Orleans, La., was dedicated, the dedication marking the completion of a project that had been under construction for more than two years and had required the construction of nearly 11,000 ft. of retaining wall in open water and the pumping of over 6,000,000 cu.yd. of hydraulic fill, in addition to the construction of runways, hangars and other structures normally required for an airport. The airport is located on made land extending into Lake Pontchartrain, about six miles north of the city. It was built by the Orleans Levee Board, a state body, at a total cost of about $3,000,000, and has been named Shushan Airport, after A. L. Shushan, president of the board. Facilities are provided for both land and sea planes.

It was considered desirable to locate the airport in Lake Pontchartrain for several reasons. One was that no money would have to be paid for such a site because it is a part of the lake bottom which is the property of the state. Another reason was that an airport so situated could not interfere with the future transit facilities of the city by interposing a solid block of land several hundred acres in extent in the pathway of continuous future street development. Still another reason was the superior advantages a site of this kind offered to fliers in ease of approach and departure and in the ease of locating the field from the air. And last, but not least, was the desire to provide facilities for hydroplanes as well as land planes, and this could best be done at a site such as the one selected on the lake.

The first step in the engineering study given to the proposed airport was the obtaining of reliable data concerning wind directions. The records of the local U. S. Weather Bureau were consulted and a tabulation was made of the day-by-day observations in terms of wind-hours for the past twelve years, which tabulation showed that the prevailing wind direction was southeast. Accordingly, a 3,900-ft. runway was projected on the map in this direction and the remainder of the runway directions were oriented from this one to conform to the cardinal points of the compass.

The southeast-northwest runway and the south-north runway having converging directions, were projected with sufficient spread between them at the shore line to extend lakeward about 4,000 ft. before intersecting. These two runways give the airport its unique and striking shape. It will be readily recognized by reference to the map that the portion of the airport situated where the relatively greater depths in the lake previously existed has been held to a minimum. This resulted in considerable economies being effected by reducing the length of the expensive portion of the retaining wall, as well as by reducing the area where the greatest amount of fill per acre was required.

Having determined upon the shape of the field and its exact location, the next step was to take borings at intervals of about 300 ft. along the wall that was to retain the filled area. The boring results indicated conditions that were not as favorable as had been anticipated. The lake bottom occupied by the outer half of the field did not present as hard a formation as that portion nearer the shore line, and indicated the necessity for long piling.

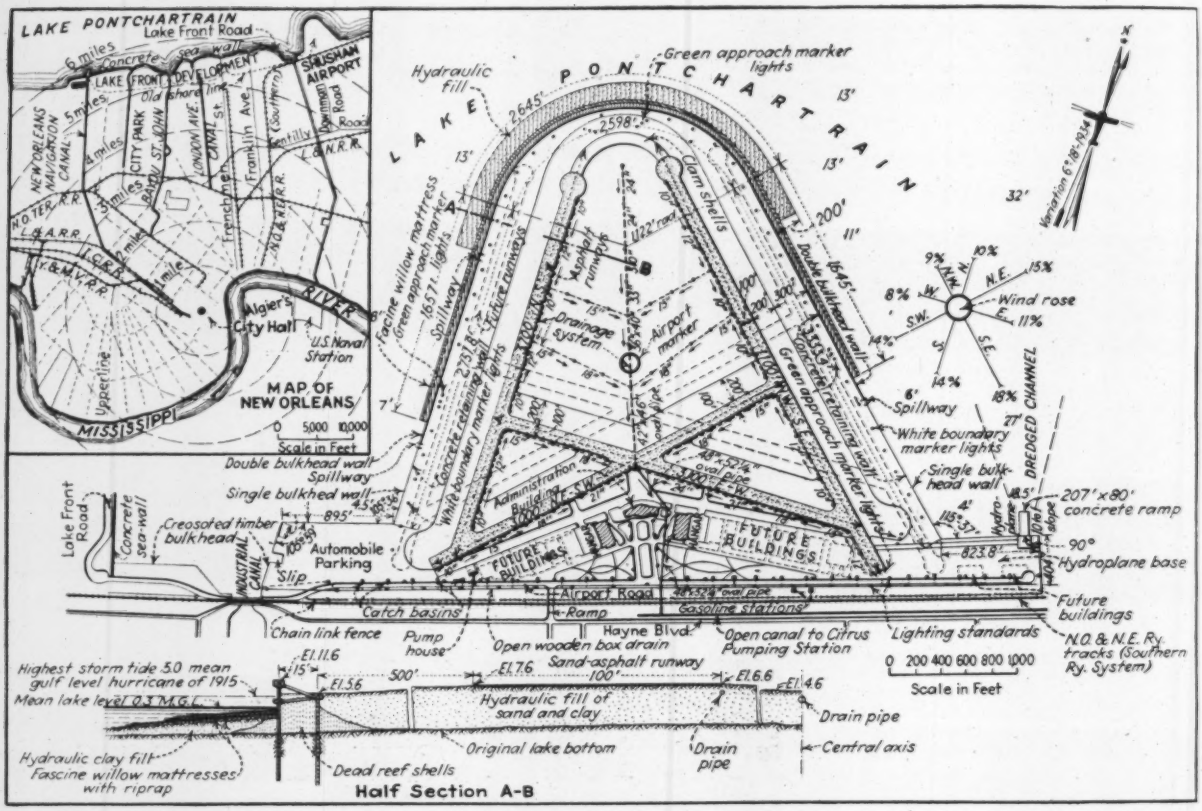


FIG. 2—SHUSHAN AIRPORT is built on made land on the south side of Lake Pontchartrain about six miles from the center of New Orleans.

Concrete test piles were driven to supplement the information obtained from borings. These piles were 12 x 12 in., 50 ft. long. Under the weight of a No. 1 hammer (10,500 lb.) and without striking a blow, they penetrated the soft lake bottom for 20 ft. At that depth a thin stratum of shell formation, varying from 3 to 5 ft. in thickness, was encountered, which was penetrated at the rate of 3 or 4 blows to the foot. Underlying this thin stratum was another formation, 6 to 8 ft. in thickness, which was penetrated by the piles without driving, the piles then "fetching up" on a hard stratum of adequate thickness to support the proposed wall at a depth of 30 to 32 ft. beneath the lake bottom. The depth of water where these conditions prevailed varied from 9 to 13 ft.

The usual type of monolithic concrete seawall built upon a pile foundation with a cutoff sheetpile wall on the exposed side would have been prohibitive in cost as it involved cofferdam construction in a lake subject to frequent storms. A seawall of the heavy riprap type, even though constructed on a mattress foundation, would have involved an unknown and difficult-to-estimate quantity of rock on account of the losses that would have to be replaced due to subsidence of the rock structure in the lake bottom. Replacement under such conditions is an expensive proposition as can be readily appreciated when it is remembered that the cost of rock for this class of work in this locality is from $5 to $6 per ton.

Retaining wall

The type of wall decided upon as best adapted to the situation was one consisting of two parallel rows of concrete sheetpiles, 15 ft. apart, driven to firm resistance, and with the front row tied to the back row with members that serve as braces as well as ties, using for this purpose 10-in. or 12-in. channels and 2-in. diam. rods with turnbuckles, all of copper-bearing steel and incased in concrete. The individual concrete piles are 24 in. wide and 12 in. thick, reinforced with eight ¾-in. rods and ⅜-in. stirrups spaced at intervals of 4-in. centers for the upper 4 ft. and at 8-in. centers for the remainder of the pile length. An extra heavy coping was included in the design to add to the beam strength of the line of sheetpiles and to serve as a wave fender.

In that portion of the lake where the water is 6 ft. or less in depth, the retaining wall consists of a single line of concrete sheetpiles tied back to creosoted timber anchor piles. The lengths of the concrete sheetpiles vary from 32 to 45 ft. for that portion of the wall where a single line is used and from 50 to 59 ft. for that portion where the double row is used. The entire length of the wall comprises 4,253 ft. of single wall and 6,693 ft. of double wall, or a combined length of 10,946 ft. The cost was $1,047,631. (A relatively short length of retaining wall was constructed along the west edge of the airport near the shore line with creosoted timber—the lighter construction being justified as storm conditions are not expected to be severe at that location.)

With the foundation conditions presented, it was realized from the beginning that some method must be devised to give the structure lateral stability. There was a freeboard height of 11 ft. plus a water depth of 12 ft. plus a soft lake bottom of 20 ft., more or less, aggregating a measurement of about 43 ft. above the plane of hard penetration. With such leverage, the 20-ft. hydraulic fill might easily push the retaining wall over and bring about its failure.

To minimize the horizontal thrust of the fill against the wall, there was provision for the placing of a backfill of oyster shells, which material was particularly suitable for the purpose in that, (1) it was obtainable within relatively short water-haul distance; (2) it was light in weight, weighing 1,600 lb. per cu.yd. in air, or practically of the same weight as water, and, therefore, was not likely to be lost through sinking in the soft bottom of the lake; and, (3) on account of the irregular size and shape of the oyster shells, this material was expected to develop an interlocking tendency that

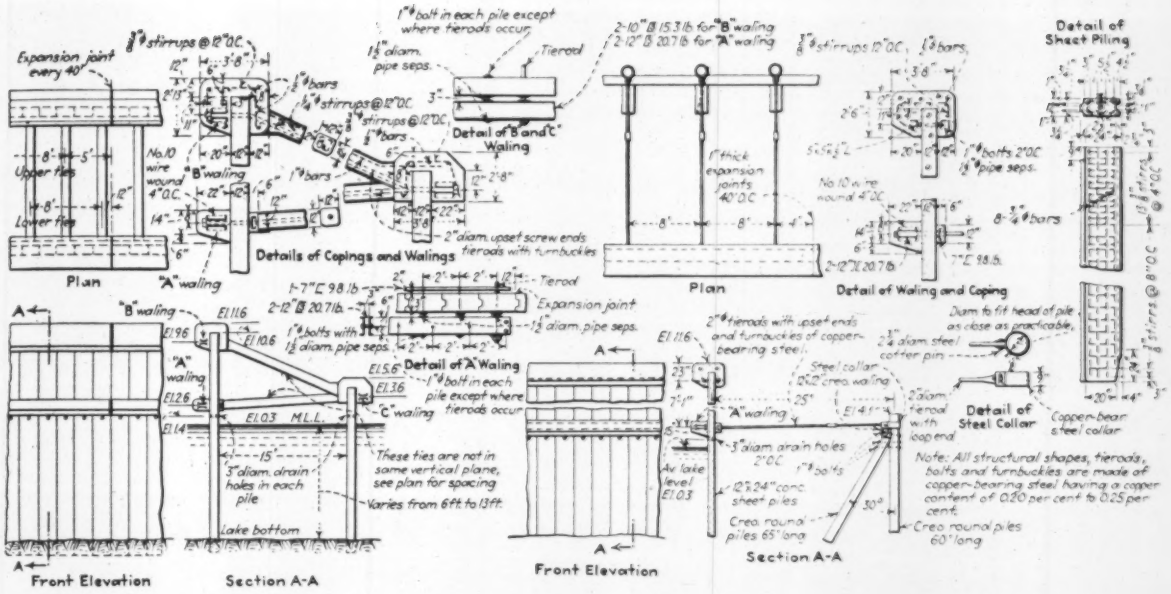

Expansion joint every 40'
Upper ties
Lower ties
No.10 wire wound 4" O.C.
"B" waling
"A" waling
Plan
Details of Copings and Walings
Detail of "B" and "C" Waling
Detail of Sheet Piling
Detail of Waling and Coping
Plan
Detail of "A" Waling
Front Elevation
Section A-A
Front Elevation
Section A-A
Detail of Steel Collar
Copper-bear steel collar
These ties are not in same vertical plane, see plan for spacing
Varies from 6ft. to 13ft.
Lake bottom
Av. lake level El. 103
Creo. round piles 65' long
Creo. round piles 60' long
Note: All structural shapes, tierods, bolts and turnbuckles are made of copper-bearing steel having a copper content of 0.20 per cent to 0.25 per cent.

FIG. 3—RETAINING WALLS of two types are used to restrain the fill forming the airport. A double row of sheetpiles, as shown at the left, is used in deep water, and in shallow water the single row shown at the right is used.

would offer resistance to displacement and in addition would take a fairly steep angle of repose. The theoretical dimensions of this oyster shell backfill were: a crown width of 15 ft. at an elevation of 5 ft. above the normal lake level and a side slope on the airport side of 1 on 1½. It developed that a slope as steep as the one above stated could not be maintained even in the enclosed area of the airport, due to wave action.

The use of oyster shell material as a backfill to the wall recommended itself also on account of the necessity of interposing a medium to prevent the sandy fill from escaping through the tongue and groove joints between the individual sheetpiles and through the 2-in. weep holes cast in each of them for drainage. The shell fill also serves as a French drain of large dimensions around the entire perimeter of the wall. The cost of the oyster shell backfill was $266,872, and is included in the cost of the wall previously cited.

Subaqueous protection work

On the lake side of the wall where the depths were in excess of 8 ft., it was considered desirable to place some underwater protective work to minimize the force of storm waves against the vertical face of the wall. This consisted of pumping a hydraulic fill of heavy clay against the wall, reducing the depths of water to about 4 ft. The fill extended outward on a slope of 1 on 50. The heavy clay displaced the softer material on the lake bottom and provided a satisfactory foundation upon which were laid two layers of willow fascine mats. Each layer of mattresses is 2 ft. thick,

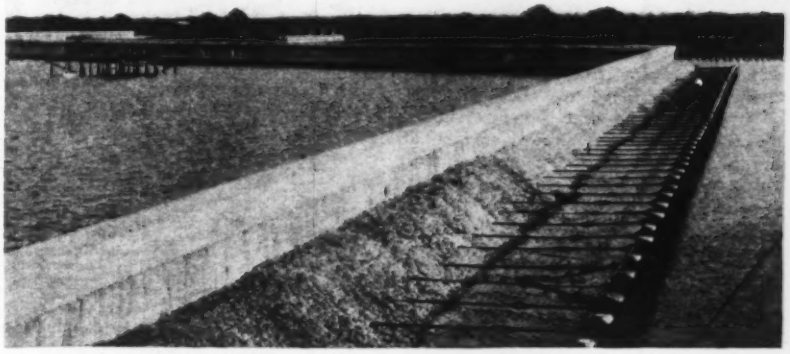


FIG. 4—THE TYPE OF RETAINING WALL used in deep water is shown in the upper picture and, below, is the wall used in shallow water. In both pictures the shell fill has been placed.

closely woven into continuous lengths of 1,000 ft., and was sunk with one edge in close contact with the wall, by adding riprap stone ballast in the amount of 50 lb. per sq.ft. The bottom mat is 60 ft. wide, and the top one 40 ft. The placing of these mats has had a noticeable effect in minimizing the spray

coming over the wall during stormy periods. The extent of this mattress protection work is 6,314 ft., as measured along the wall, and the cost was $156,050.

Hydraulic fill

Filling the enclosed area of the airport began even before the completion of the retaining wall. Forty or more borings in available pit spaces were taken to determine the location of pits that contained the best material for the proposed fill. It developed that sand pits were not as prevalent as had been anticipated. Hence, an attempt was made to construct all that part of the fill that was below lake level with clay and to conserve the available sandy material for constructing the upper layer so as to facilitate surface drainage. This was adhered to generally, but practical difficulties prevented the method being carried out as closely as was desired.

The filling operations progressed very well considering frequent interruption through storm damage to pontoon lines. The dredges began work on Feb. 24, 1932, and completed the work on Dec. 6, 1932. In that period 6,269,700 cu.yd. of material were placed. The discharge pipe line at times exceeded 6,000 ft. in length. The contract price was 13.9 cents per cu.yd. for material measured in place, and the total cost with allowed extras and deductions for demurrage, was $861,456.

An unexpected development arose in connection with the filling operations which for a time threatened to become troublesome but was finally overcome. The lake bottom contains a very finely divided argillaceous material. It is light enough to be carried in suspension without any stream velocity. As the filling operations progressed, this material was noted in suspension in the airport area some 8 or 10 in. below the clear water surface, appearing to the eye as dense hydraulic fill. Upon probing with a stick, it was found to be very liquid, not being even as viscous as a thick soup. As the filling progressed this material seemed to become thicker, somewhat similar to the consistency of clabber.

It was realized that this material, if permitted to spread on the surface of the airport, might be a deterrent to quick absorption of rainfall and otherwise objectionable. The discharge lines of the dredge, therefore, were manipulated through flanking movements to crowd it to the spillways; but as the area into which it was confined became smaller it no longer flowed to the spillway but increased in elevation, the surface becoming corrugated and furrowed. In this condition it extended over an area of about 20 acres and was 5 to 6 ft. deep. One or two weeks' exposure to the sun was productive of a green mold. The waste water from the dredge's discharge lines no longer moved it, but cut well-defined channels through the formation. Finally it was pushed out bodily by the lateral advance of the sand fill until it was past the runway area.

It is believed that the relatively limited number of spillway openings in the wall might account for the unusual amount of this colloidal material that was present, and that much more adequate provisions should be made in the matter of spillways on other work of a similar nature.

Drainage

Recognition was given at all times to the necessity of providing adequate drainage to the runways. To accomplish this, low broad ridges were built on the same alignment as the axes of the proposed runways. The predominant runways that converge in the lakeward direction occupy the crest of a ridge built parallel to the circumscribing retaining wall and at a distance of 500 ft. therefrom. This ridge serves to separate the drainage of the field into two well-defined watersheds. The area in the outer 500-ft.-wide strip (about 119 acres) slopes to the retaining wall and is drained without resort to pipe lines or auxiliary drainage structures to the shell backfill immediately behind the retaining wall. The remainder of the area in the field (182 acres) slopes to a central valley located along the north and south axis of the field. The main drainage line is necessarily located in this valley and leads to an open canal connected with the city's drainage system. In this canal the water elevation is held (by a drainage pumping station) at a stage equivalent to 7 ft. lower than the lowest area in the airport. This is a greater difference in elevation than obtains between the low area in the airport and the lake during adverse storm tides, and explains why the drainage is not taken into the lake. It should be stated also in this connection that heavy rainfalls in this locality are usually coincident with storm tides that vary from 3 to 3½ ft. above normal lake level.

To guard against what is recognized as a remote contingency, namely, a very severe storm sending waves over the wall, to the extent that the area between the wall and the runway ridge would be flooded by impounded water unable to escape through the vertical joints between the sheetpiles, there have been provided four 40-ft. spillways with serrated openings.

The drainage lines are all built of concrete pipe and range from 10-in. diameter to the large oval culvert, 52 by 48 in. All pipe over 24 in. diam. is reinforced. On account of the fact that these pipes are laid in a recently created fill that will be subject to variations in settlement, a wooden decking of transverse and longitudinal cypress planking was placed in the bottom of the excavation, which planking carries a 6-in. layer of clam shells as a foundation upon which the pipe is bedded. The pipe line grades vary from 0.25 to 0.50 per cent for the smaller sizes, and on the large oval section the grade is 0.12 per cent. The average depth to the invert is 5 ft. and the minimum cover is 2 ft.

The backfill for the pipe lines along the edge of the runways is made with clam shells to within 12 in. of the

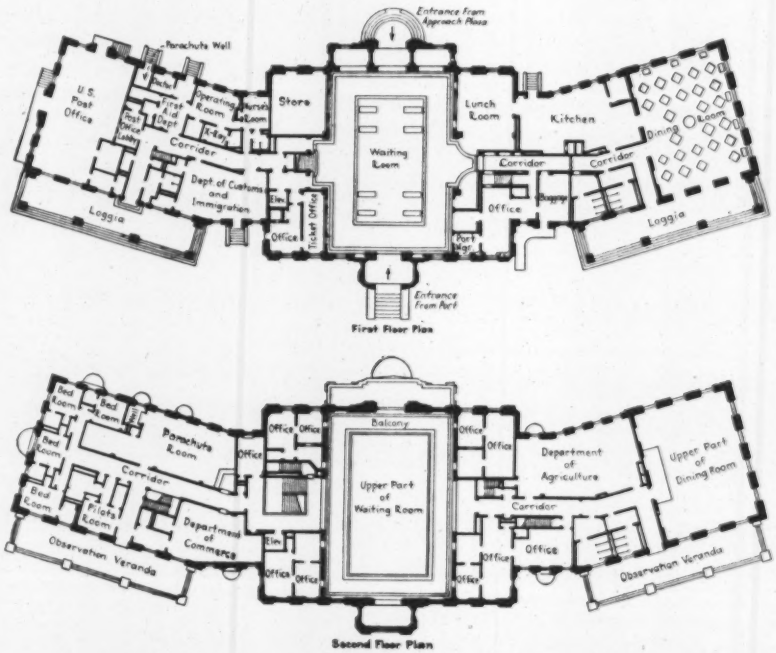


FIG. 5—THE TWO PRINCIPAL FLOORS of the administration building contain space for three federal departments, immigration, commerce and post office, in addition to the usual terminal facilities and offices.

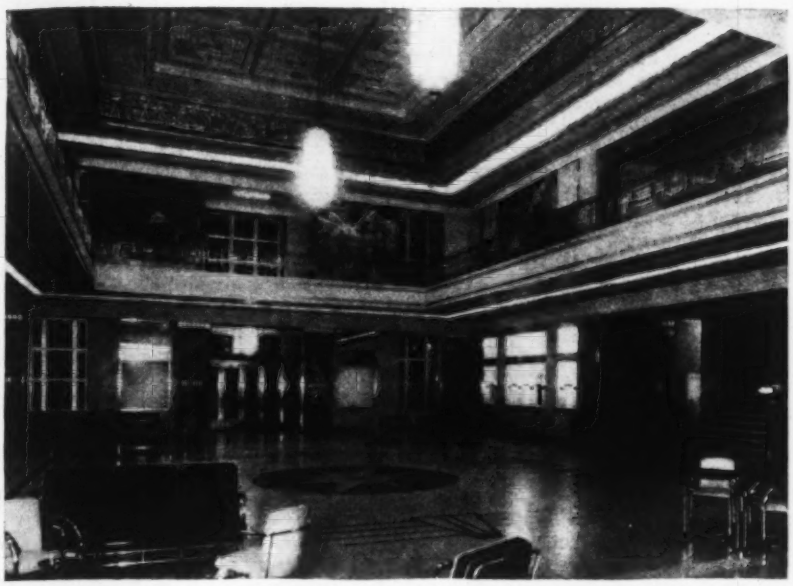


FIG. 7—THE MAIN LOBBY of the administration building is a room two stories in height. Its modernistic design is typical of the entire building.

ground surface and finished with a 12-in. topping of 2-in. size slag; the slag is run through a mixer and coated with an asphaltic emulsion before being placed in the trench.

The drainage pipe used is of the bell and spigot type. Because the fineness of the sand constitutes a large part of the filled area, special precautions had to be taken in the installation of the drain lines in order to avoid the possibility of sand filling these drains. Drain lines that served as connecting lines were laid with cemented joints. In the installation of drain lines where a backfill of porous material was used, the joints were cemented for the lower quadrant of the circumference; that is to say, for a distance equivalent to 45 deg. on either side of the center of the invert of the pipe and for the remainder of the circumference, the joint was packed with a fold of two plies of 20-mesh copper wire fabric which was held snugly in place against the bell and spigot surfaces by driving wedges made of brass strips ½ in. wide and ⅛ in. thick at intervals of 6 in. around the circumference of the pipe. This device has been successful in permitting the runoff to get into the pipe line, at the same time excluding fine sand.

Runways

The kind of material to be used for the runway surfacing was limited by physical conditions of the field to some type of asphaltic mixture; for with the prospect of subsidence taking place over the entire area of the field as the water table was lowered, concrete runways were out of the question even if the item of greater cost were left out of consideration.

The hydraulic filling was not uniformly sandy enough to advise the construction of mixed-in-place runway surfaces. There was, however, a deposit of fairly clean sand encountered during the hydraulic-filling operations, which had been spotted for future reference; and when the filling was completed, 20,000 cu.yd. of this material was pumped into a stock pile to be used in a plant-mixed asphalt product for runway construction. A screen analysis showed this sand to have the following composition:

	Per cent
Passing 200	8
Passing 100	28
Passing 80	39
Passing 40	24
Passing 10	1
	100

Attempts to design an asphalt mixture with this sand alone led to the conclusion that an unjustifiable amount of asphalt cement and mineral filler would be required to produce a stable mix. Trial mixtures therefore were made with addition of commercial sand in variable quantities with variable results. A satisfactory compound was finally obtained by using an admixture of 50 per cent of commercial sand and 50 per cent of airport sand. The resulting sand mixture screened as follows:

	Per cent
Passing 200	3
Passing 100	10
Passing 80	15
Passing 40	40.5
Passing 10	28.5
Passing 1/4	3
	100.0

To the above was added 8 per cent of mineral filler and 7.5 per cent of bitumen.

While the above combination of sands was not an ideal asphaltic grading, it approached it sufficiently to be acceptable. For purposes of inspection and study, samples of surfacing were laid on the runway areas, using this sand grading in combination with cut-back asphalt of slow curing and of medium curing qualities. Samples were also laid, using asphaltic emulsions as the cementing medium; and a sample of straight hot-asphalt surfacing was also laid.

The sample of surfacings constructed with emulsified asphalt was chosen as the type to be used. This asphaltic product is a mixture of 60 per cent hot asphalt of 40-50 penetration and 40 per cent of bituminous binder. The surfacing of the four runways, 3,900, 3,500, 3,200, and 3,100 ft., respectively in length and for a width of 100 ft., comprises a total of 143,247 sq.yd. This work was constructed for the unit price of 72c. per square yard, 4 in. thick. The cost of the runways, including certain items of extra work, was $107,985.

In order to add to the illumination of the runways when used at night, they were given a surface treatment consisting of an application of one-tenth of a gallon of emulsified asphalt per square yard and a covering of oyster shell screenings to the extent of 5 lb. per square yard. A total of 139,632 sq.yd. of surface was so treated at the unit price of 7c. per square yard, involving a cost of $9,774.

Taxiway pavement

In providing the airport with a pavement for the taxiway, it was not necessary to give consideration to the question of resiliency of surface, a desirable quality to be sought in surfacing runways. Accordingly, for the paving of the taxiway, hangar aprons and other road surfaces that would be called upon to meet the requirements of vehicular traffic, it was decided to construct a 4-in. bituminous foundation surfaced with a wearing course of crushed natural limestone rock asphalt, properly fluxed, 1 in. thick. It was desired thus to provide a type of pavement that would best withstand the cracking of the surface or deterioration that might reasonably be expected during extended periods of limited use. This pavement, totaling 57,366 sq.yd., was laid at a cost of $1.60 per square yard for the 5-in. thickness.

Hydroplane ramp

A hydroplane ramp, 80 ft. wide and 207 ft. in length, was constructed on the eastern extremity of the airport. This ramp was built on a uniform slope of 1:10. At normal lake level, the outer end for a length of 80 ft. is submerged. The ramp is built along the lines of approved concrete wharf construction. For its support, reinforced-concrete piles 16 in. square were driven, spaced 8 ft. centers longitudinally and 16 ft. centers transversely. They varied in length from 32 to 14 ft. Longitudinal concrete beams, 16x20 in., on 16-ft. centers, and transverse beams, 12x16 in., on 4-ft. centers resting on the piles support an 8-in.

concrete slab to which has been attached a creosoted lumber decking of 3x8-in. material, with 1-in. spacings. This decking reduces the damage that otherwise would be done to the hull of a hydroplane by abrasion and also provides a more secure footing for the operators at the hydroplane landing who may have to wade on the submerged portion. The cost of the hydroplane ramp complete in all its details, but exclusive of the dredged channel approach, was $40,978.

Airport buildings

The principal buildings of the airport are an administration building and two hangars. The administration building is located on the central axis of the field and the two hangars are placed to the east and west of this building and border along taxiways which extend from the central axis to the east and west end of the field, as shown in Fig. 2. Space is provided for additional hangars along the taxiways as required, the ultimate development anticipating a total of twelve hangars for the accommodation of land and sea planes.

The airport buildings are of fire-resistant construction, being built entirely of concrete, steel and tile. The exterior treatment is a light tan artificial stone with exposed fine aggregates of crushed marble and rock.

The administration building is symmetrically planned with a large waiting room serving as the central feature. This room is 50x80 ft. and extends up through the two main stories of the building. It contains all the facilities of the modern passenger terminal, including accommodations for telegraph companies, telephone booths and completely equipped ticket offices, also space for news stands, a store and lunchroom.

The building also contains the port manager's office, an air-mail post office, a fully-equipped first-aid section, quarters for the federal customs, commercial, agriculture and immigration departments, including detention rooms and accommodation for a meteorologist, office space for the air navigation companies, a large parachute storage and inspection room, including a two-story well, pilots' room and a small group of bed rooms.

Above the central axis of the building, with its floor 60 ft. above the field, is the control tower, an octagonal room entirely enclosed in glass set in an aluminum framework. The glass employed is a special heat-resisting product of a bluish-green color, which insulates the room against exterior heat and softens the otherwise excessive glare. Provision has been made here for the direction and scheduling of planes and for communication with them, also for the reception of weather reports and other radio messages. Every part of the field, including the taxiways, is visible from this room which has, as well, an unobstructed view of planes approaching the field from any direction.

Aluminum has been used freely on the exterior of the building for marquees at the various entrances, for spandrel panels, railings for observation decks and stairs, as well as for doors and windows. This has been done both for architectural effect and to reduce maintenance to a minimum.

Each hangar is 200 ft. wide by 100 ft. deep, fronting on a 150-ft. apron that ultimately will serve two hangars. Across the entire rear each is provided with two fully equipped shops with the necessary complement of locker rooms, and at the front, flanking each side of the main door, are towers containing office space. The hangar doors have a clear opening 200 ft. wide and 26 ft. high and operate in two 100-ft. units, either separately or simultaneously.

At the south side of the present hangars are extensions containing, in the one case, transformers and the main switchboard room, with provision for an emergency electric generator unit, and steam boilers for heating the buildings thus far erected. In the other case, the extension accommodates the ambulance, the emergency or field trucks and other mobile field equipment.

Landing field lighting

The landing field lighting includes 34 white boundary marker lamps mounted on wing-type cones painted orange and black for day marking, 24 green approach markers of the same type, three being placed at the end of each of the eight runways, also 20 flush white boundary lights to outline the entire field for pilots in the air. To inform pilots of the true wind direction there are five illuminated wind cones on the field, one on top of the administration building and a special illuminated wind tee on top of one of the hangars for night observations.

The landing field floodlight system consists of eight banks of floodlights placed at the end of each runway, each bank consisting of three 3-kw. projectors, a total of 4,230,000 beam candlepower for the group. This provides sufficient illumination to reveal the details of the surface and to make depth perception readily possible from an altitude of about 50 ft. in the center of the lighted area of the runway. To minimize the effect of fogs and hazy weather a minimum illuminating intensity of 0.25 foot-candle has been provided in lieu of the 0.15 required by the aeronautics branch of the Department of Commerce.

In addition to the main floodlight projecting units, there is one 1.5-kw. auxiliary unit on each runway with its beam lapping the spill of the beam from the main unit.

Red obstruction lights are located on each building, on radio masts and the beacon tower, and along the main airport roadway.

One 36-in. double-beam revolving beacon and one auxiliary beacon are mounted on a steel tower on one of the hangars. Each of the double beams is about 1,800,000 cp., and has a visibility of about 60 miles in clear weather. In the base of the revolving beacon a gear and cam mechanism is provided to produce a Morse letter code of the airport by green lighting flashes of the auxiliary beacon.

On top of one of the hangars is an illuminated airport sign, also an arrow shaft indicating true north.

One ceiling-height projector is provided, together with an alidade to measure the height of the ceiling or lower cloud banks, the projector being arranged for direct reading of the height on the scale of the alidade.

Mounted on top of the control room tower is one anemometer and one wind-direction vane, both operating direct-reading electrical instruments on the control desk of the tower.

Lighting control system

The entire landing field lighting system is operated from the control desk in the control tower, each unit being separately controlled by individual switches with pilot-lamp indicators.

The operating sequence of the floodlight banks is as follows: from the wind indicator the dispatcher at the control desk determines the true wind direction. If the wind is from the north requiring an airplane to approach from the south, the dispatcher turns on the bank of floodlights at the south end of the north-south runway. Should sudden changes in wind direction require the use of another runway, the change is immediately apparent to the dispatcher.

The engineering work has been under the direction of the writer, assisted by the following engineers in the employ of the Orleans Levee Board: W. B. Davey, principal assistant engineer; A. L. Willoz, office engineer; E. E. Elam and E. C. Hyatt, assistant engineers in the field. Mr. Elam now is general manager of the airport.

The firm of Weiss, Dreyfous & Seiferth, New Orleans, was architect for the airport buildings and designed the lighting system. On the latter, Wm. H. Ennis, New Orleans, acted as consulting electrical engineer.

The contractors engaged on this project were as follows: retaining wall, The Fuller Construction Co., Dallas, Texas; hydraulic fill, The Orleans Dredging Co., New Orleans; sub-aqueous mattress work, Lester F. Alexander, New Orleans; paving of runways, taxiways and roads, The Wesco Construction Co., Chattanooga, Tenn.; hydroplane ramp and creosoted timber bulkheads, W. Horace Williams Co., Inc., New Orleans; installation of sub-surface drainage, A. P. Boh and Co., and Mike Mitchell Sons, New Orleans; buildings, Caldwell Brothers & Hart, New Orleans.

Preventing Ditch Erosion by Check Dams

Design of road side-ditch grades and cross-sections and of check dams to reduce velocity of current in loose-soil ditches

By Searcy B. Slack
Decatur, Ga.

DITCH EROSION is a phase of roadway depreciation that has been generally considered in theory more than in practice, although recent practice in the Mississippi Valley states shows some remarkably well-designed across-road profiles for handling water on pavement, ditches and side slopes in easily eroded soils. In the general run of roadway the conditions described in this article probably are present more often than they are absent. The following discussion, coming from the former engineer of bridges of the Georgia highway department, is therefore of importance. It presents well-considered experience in the design and construction of cross-dams or checks in side ditches. —EDITOR.

THE PROGRESSIVE erosion or scour of ditches along the sides of highways constitutes a real problem in construction and maintenance. In many sections the soil is easily eroded, and wherever the cover of vegetation is removed steps must be taken to prevent or check soil erosion. The farmers handle the problem by terraces and hillside ditches on flat grades. In railroad work the easy grades make the problem much simpler than on the steep grades common on road work.

On some of the older locations where the roads were not surfaced, the level of the road has gradually been lowered by erosion, largely by wash in the ditches, until the road is much below the level of the surrounding country, and in many cases in a rather deep cut with large ditches on one or both sides. In reconstructing these roads it is generally cheaper and easier to relocate the road than to fill the ditches and check ditch erosion. Numbers of these old roads have become large ditches or gullies. Relocation, or change in level, of a surfaced highway or a well-constructed lateral road is a costly undertaking. Experience amply justifies provision in the original construction for checking or controlling erosion in the side ditches.

On much new work the problem of checking ditch erosion along the road or highway is slighted during construction, with the expectation that it is to be handled by maintenance forces. This places an unfair burden on maintenance, as sections, grades and location should be considered in advance study.

Methods of checking erosion

The amount of erosion that occurs when water passes along an earth ditch is determined by the character of the soil and by the velocity of the water. If the soil is light—that is, composed of fine sand, loam and a small amount of clay—it is very easily eroded. The coarse sands and stiffer clays do not scour so readily.

The velocity of water flowing through an open ditch is determined by the grade of the ditch bottom and by the shape of the ditch. In a flat-bottom ditch with a shallow flow of water, the velocity will be slow as compared with a narrower ditch with a deeper flow of water. The ordinary V-bottom ditch has a tendency to concentrate the water in a small area and gives a higher velocity of flow than a flat-bottom ditch where the water is spread over a larger area.

Much can be done in checking velocity of flow on light grades by using flat-bottom ditches of ample width. To prevent scour on the steeper grades, the grade of the ditch should be reduced or the water carried in some form of conduit. An effective method of reducing the ditch grade is to provide a series of breaks or checks along the ditch so that the water goes down by a series of small falls, as shown in Fig. 3, while the ditch grade between the checks is rather flat. The grade of the ditch between the checks should be determined by the character of the soil, flat grades (less than 1 per cent) being used for light soils. In some of the heavier soils no serious scour occurs on grades as steep as 1½ to 2 per cent. The ditch grade to be used should be decided upon after an inspection of ditches in the immediate vicinity.

Deep side-ditches are unsightly, dangerous and hard to maintain to proper section, so the ditch line should follow the grade of the highway as nearly as practicable. A larger number of ditch checks with small falls (6 to 9 in.) serve better than a smaller number with greater falls (24 to 30 in.). If the fall at the ditch check is large, the depth of the ditch increases materially at each check and it is much more difficult to maintain the slopes around the check. Good results have been secured with ditch checks having falls of 6 to 8 in. About the same amount of material is required for one ditch check having a fall of 24 in., as is required for three ditch checks having a fall of 8 in. each. In case of a washout, some of which are to be expected, the damage is much less with the smaller checks.

The ditch checks should be constructed with aprons on the downstream side to prevent undercutting when the water flows over the check. These aprons should be of ample width, and

FIG. 1—DESIGN DETAILS of three types of ditch checks that have been used on Georgia highways.

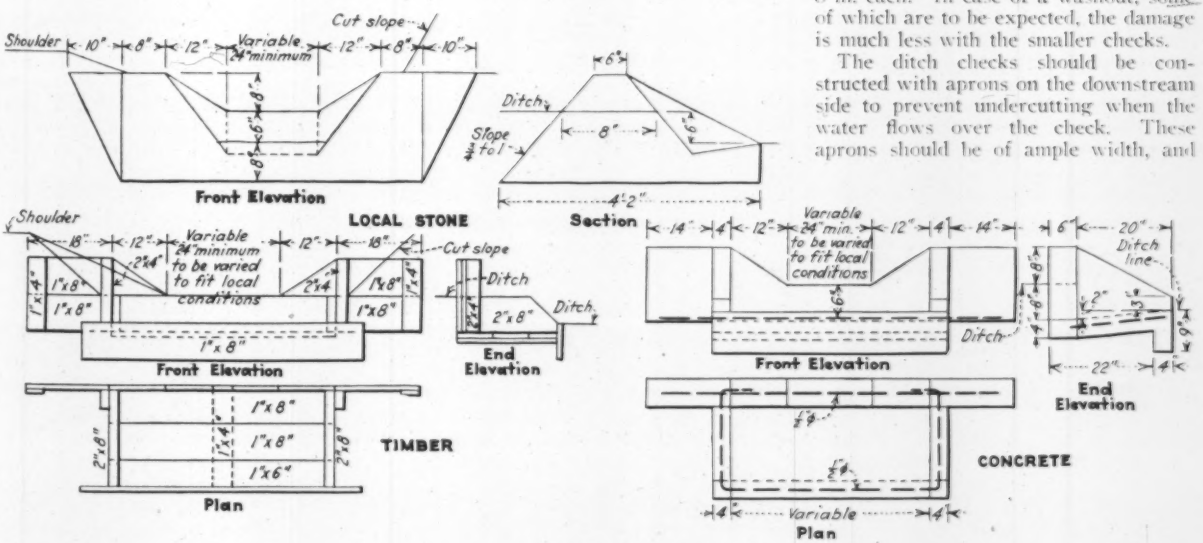


FIG. 2—SECTION of Georgia highway on which about 2,000 creosoted checks were placed in side ditches.

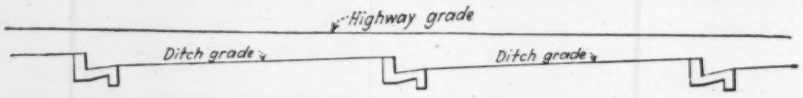


FIG. 3—LONGITUDINAL PROFILE of ditch bottom and road surface, showing manner of placing checks or cross-dams.

experience indicates that they should be a little below the lower ditch grade.

Three designs for ditch checks using local stone, concrete and treated timber are shown in Fig. 1. The local stone and timber ditch checks have some advantage over the concrete checks in that they can be more easily reset in case of a washout.

Installation of ditch checks

A simple rule for determining the number of ditch checks required is to subtract the per cent of grade (fall per 100 ft.) allowable in the ditch from the per cent grade of the highway and divide the result by the fall of each check in feet. This gives the number of checks for each 100 ft.

In installing the ditch checks, considerable care should be taken to tamp backfill material under and around the checks. In some light soils it is best to excavate the light material where the check is to be placed and to backfill with clay or other better local material that is not so easily eroded.

The length of the discharge weir of the ditch checks should be increased with an increasing amount of water in the ditch. Starting with a nominal width of 2 ft. near the top of a grade, this width should be increased as the volume of the water increases down the grade. It should be borne in mind that concentrating the water defeats the very purpose for which the ditch checks are installed.

The cost of installing ditch checks varies widely with local conditions. On one project in Georgia in 1932, about 2,000 ditch checks of cresoted timber were placed at a cost of about $3 per check, or 22c. per linear-foot of ditch protected. This is a very nominal cost when compared with the cost of a flume or other type of protection. After fifteen months of service, washouts of only seventeen of these 2,000 checks were reported. A part of the installation is shown in Fig. 2.

FIG. 4—EFFECTS of ditch erosion (A) on outside bank slopes and (B) on inside slope threatening road shoulder.

Erosion in berm ditches along the top of the cuts is quite as serious as scour in the side ditches of the road. While the effect is not apparent quite so soon when viewed from the roadway, a deep ditch washed along the top of a cut will soon break through and cause caving and further scour. On account of irregular grades in the berm ditches, the erosion is harder to handle. Berm ditches to protect cuts through easily eroded soil are of very doubtful value. In many cases it is better to widen the side ditches of the road and bring the water down from the top of the cut than to have the berm ditches scour—that is, where the water cannot be handled in some simpler way. Location should be made with a view to handling the water.

One of the main causes of the sloughing of cut slopes is undercutting the bottom of the slope at the back of the ditch by scour in the ditch, or by the end of a road-machine blade used in cleaning the ditches. Trimming back cut slopes and planting them is rightly being given more and more attention, but much of this work will be wasted unless the toe of the slope at the back of the ditch is protected.

Summary

If highway and road work are to be considered in any measure permanent, more attention must be given to checking and controlling ditch erosion. Consideration of this phase of the work should be given before construction plans are completed.

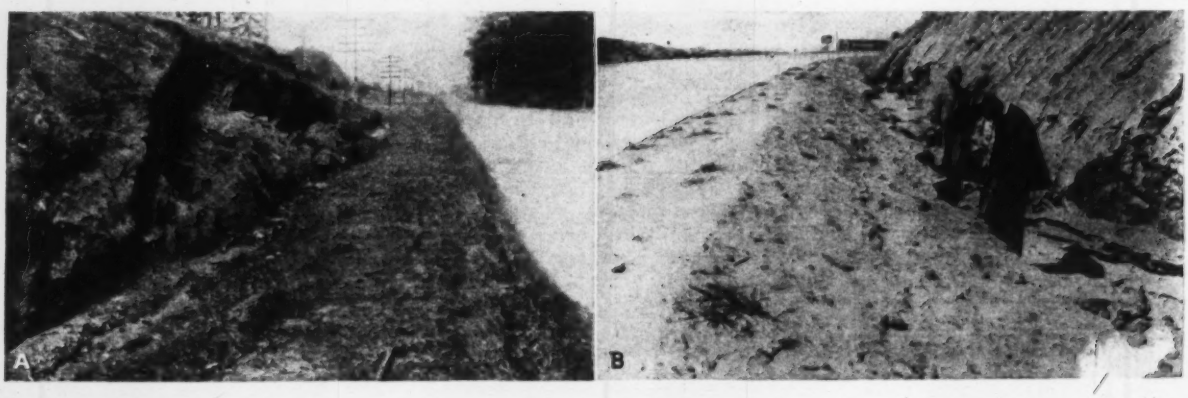
Scour in the ditches is much easier and cheaper to handle in the early stages than after serious washes have occurred.

Flat-bottom ditches are better for checking erosion than V-bottom ditches.

Ditch checks with small falls spaced at short intervals are effective in controlling scour and are easier to maintain and safer than checks having larger falls.

Scour in the berm ditches along the top of cuts is almost as serious as scour in the side ditches.

To stabilize cut slopes, the toes of the slopes at the back of the ditches must be protected against undercutting.



Continuous Beam Design by Successive Influence Lines

By I. Duberstein
Civil Engineer, New York, N. Y.

THE SOLUTION of a continuous beam of any number of supports may, with the recognition of a group of special theorems, be obtained wholly by simple arithmetical calculations and without the necessity of memorizing or referring to any formulas. These theorems are as follows:

1. The reaction of any support of a continuous structure may be regarded as a load on a structure of a preceding stage of indeterminateness.

2. Any reaction of a continuous structure $R_1R_2R_3 \ldots R_n$ can be solved by successive steps by starting out with a simple structure R_1R_n.

3. The influence line for the reaction at any support of a continuous beam is given by an elastic curve obtained for a unit load applied at that support, the support being considered removed.

It is evident from the above that the solution is based on Maxwell's reciprocal theorem. The procedure requires the calculation of an auxiliary simple beam-deflection curve, and this curve is obtained by the moment-area method. Any other method could be used, but the advantage of the moment-area method consists in the fact that it relieves the computer from depending either on his memory or on written formulas. A graphical solution for continuous beams, based upon the same concept, was published by the writer in *Engineering News-Record*, May 28, 1925, p. 886.

In the following, the analytical method is developed by step-by-step procedure. In considering a beam $R_1R_2R_3R_4$, its reaction influence lines are determined by means of the following steps:

First, consider the simple beam R_1R_4 subjected to a unit load at R_2, reactions R_2 and R_3 being considered removed. This results in the triangular bending-moment diagram ABC of Fig. 1. Next consider the beam R_1R_4 under the above triangular load distribution, and compute bending moments at various divisions of the beam due to this assumed loading. The calculation for points 5, 10, 15, 20 and 25 follows in full.

The original bending moment at point 10 due to the unit load at point 10 of

$$R_1R_4 = M_{10} = \frac{2}{3} \cdot \frac{L}{3} = \frac{2L}{9}$$

The moment area $ABD = \frac{1}{2} \cdot \frac{2L}{9} \cdot \frac{L}{3} = \frac{L^2}{27}$ and the moment area $BCD = \frac{2L^2}{27}$

Then $R_1' = \left(\frac{L^2}{27} \cdot \frac{7L}{9} + \frac{2L^2}{27} \cdot \frac{4L}{9}\right) \Big/ L = \frac{5L^2}{81}$ and $R_4'' = \frac{4L^2}{81}$

Finally $M_5' = \frac{5L^2}{81} \cdot \frac{L}{6} - \frac{1}{4} \cdot \frac{L^2}{27} \cdot \frac{L}{18} = \frac{19L^3}{81 \times 24}$

$$M_{10}' = \frac{5L^2}{81} \cdot \frac{L}{3} - \frac{L^2}{27} \cdot \frac{L}{9} = \frac{4L^3}{81 \times 3}$$

$$M_{15}' = \frac{4L^2}{81} \cdot \frac{L}{2} - \frac{9}{16} \cdot \frac{2L^2}{27} \cdot \frac{L}{6} = \frac{23L^3}{81 \times 16}$$

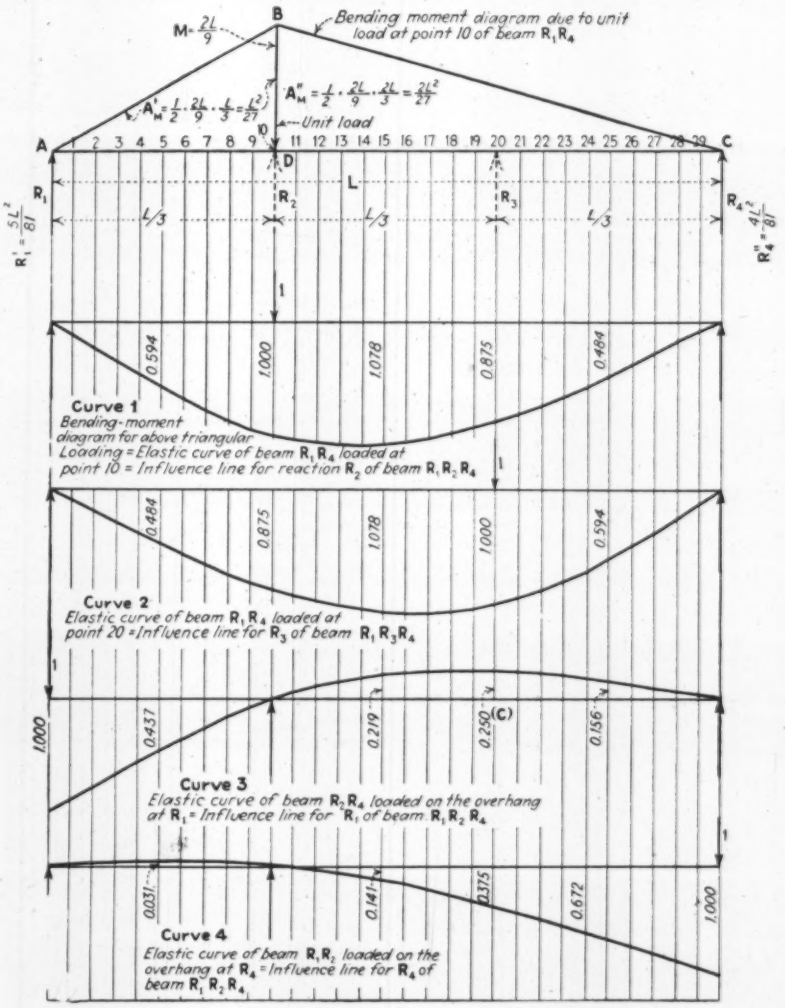
$$M_{20}' = \frac{4L^2}{81} \cdot \frac{L}{3} - \frac{1}{4} \cdot \frac{2L^2}{27} \cdot \frac{L}{9} = \frac{7L^3}{81 \times 6}$$

$$M_{25}' = \frac{4L^2}{81} \cdot \frac{L}{6} - \frac{1}{16} \cdot \frac{2L^2}{27} \cdot \frac{L}{18} = \frac{31L^3}{81 \times 48}$$

From the moment-area theory the above quantities M' are proportional to the ordinates of the elastic curve of beam R_1R_4 subjected to a load at R_2. It follows from the general principle (No. 3 above) that if the above quantities M' are divided by M_{10}'—i.e., $4L^3/81 \times 3$—the value of the reaction R_2 of beam $R_1R_2R_4$ for a unit load traveling along the beam is obtained. Therefore, by multiplying the quantities M' by $81 \times 3/4L^3$ the ordinates for the influence lines for R_2 of beam $R_1R_2R_4$ are determined (curve No. 1 of Fig. 1).

The elastic curve 2 of Fig. 1 is due to

FIG. 1—ELASTIC-INFLUENCE LINES used as auxiliaries for the solution of beam $R_1R_2R_3R_4$.


Bending moment diagram due to unit load at point 10 of beam R1R4
Unit load
Curve 1
Bending-moment diagram for above triangular Loading = Elastic curve of beam R1R4 loaded at point 10 = Influence line for reaction R2 of beam R1R2R4
Curve 2
Elastic curve of beam R1R4 loaded at point 20 = Influence line for R3 of beam R1R3R4
Curve 3
Elastic curve of beam R2R4 loaded on the overhang at R1 = Influence line for R1 of beam R1R2R4
Curve 4
Elastic curve of beam R1R2 loaded on the overhang at R4 = Influence line for R4 of beam R1R2R4

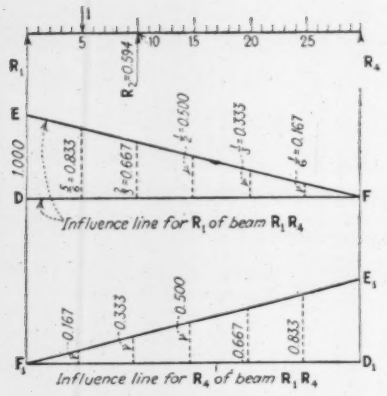


FIG. 2—REACTION-INFLUENCE LINES for beam R_1R_4 used to obtain influence lines for reactions R_1 and R_4 of beam $R_1R_2R_4$.

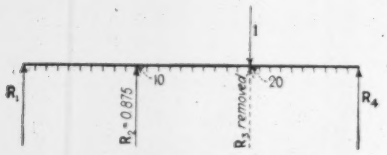


FIG. 3—METHOD OF LOADING on beam R_1R_4 to obtain influence line for R_2 of beam $R_1R_2R_3R_4$. The reaction R_2 of beam $R_1R_2R_4$ loaded at point 20 is regarded as an upward load on beam R_1R_4.

a unit load acting on beam R_1R_4 at R_2 or point 20. It is obtained from symmetry by plotting the ordinates of curve 1 in reverse order.

From curve 1, the reaction R_2 of beam $R_1R_2R_4$ is known for the various positions of a traveling load. This reaction can be considered as a load acting upward on the beam R_2R_4, and the reaction R_1 of beam $R_1R_2R_4$ can be obtained from an influence line for reaction R_1 of beam R_1R_4. The latter influence line is given by a triangle having its vertex at R_1, as shown in Fig. 2. The reaction R_1 is computed as follows:

Pt. 5 : $R_1 = 0.833 - 0.594 \times 0.667 = +0.437$
Pt. 10 : $R_1 = 0.$
Pt. 15 : $R_1 = 0.500 - 1.078 \times 0.667 = -0.219$
Pt. 20 : $R_1 = 0.333 - 0.875 \times 0.667 = -0.250$
Pt. 25 : $R_1 = 0.167 - 0.484 \times 0.667 = -0.156$

In a similar manner the values of R_1 for the other points are computed and plotted in curve No. 3 of Fig. 1, representing the influence line of R_1 of beam $R_1R_2R_4$.

The influence line for R_4 of beam R_2R_4 shown by curve 4 of Fig. 1 was obtained by similar procedure. In this case curve No. 1 of Fig. 1 and the influence triangle $F_1E_1D_1$ in Fig. 2 are utilized.

As a check on the computations, for every position of the load, $R_1 + R_2 + R_4 = 1$. For exaample, at point 5, using curves 1, 3 and 4 of Fig. 1: $R_1 + R_2 + R_4 = 0.594 + 0.437 - 0.031 = 1.000$.

Curves 1, 2, 3 and 4 of Fig. 1 can now be used as auxiliaries for the calculation of the influence lines of the reactions of beam $R_1R_2R_3R_4$. In order to obtain the influence line for the reaction R_2, the reaction is replaced by a unit load, giving the beam $R_1R_2R_4$ subjected to a unit load at point 20 (Fig. 3).

In Fig. 3 the value of $R_2 = 0.875$ is obtained from curve 1 of Fig. 1 for the position of the unit load at point 20. The elastic curve of the simple beam R_1R_4 subjected to a downward unit load at point 20 and an upward load = 0.875 at point 10 is identical with the elastic curve of beam $R_1R_2R_4$ produced by a unit load at point 20, and the latter curve is the influence line for reaction R_2 of beam $R_1R_2R_3R_4$. Therefore, to determine the elastic curve of the simple beam R_1R_4 under the loading shown in Fig. 3, it is first necessary to note that the ordinates of the curve are proportional to the quantities:

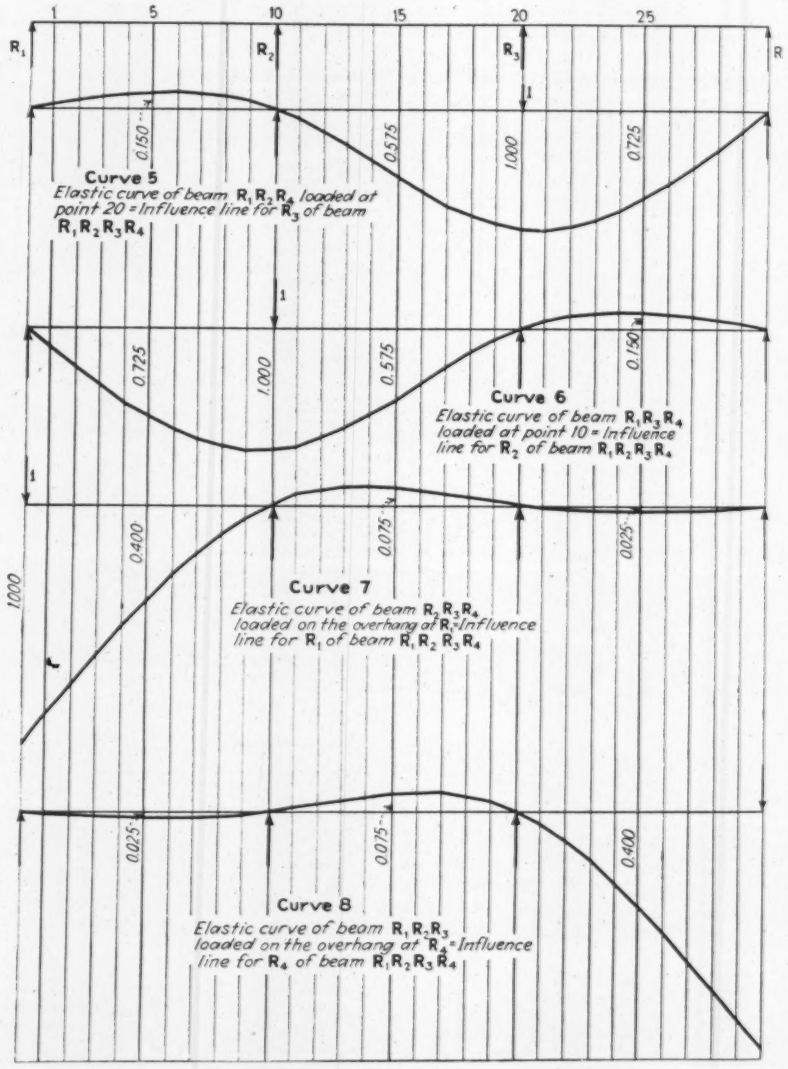
$$d_p = d'' - 0.875d'$$

where d'' = ordinates of curve 2 (Fig. 1), and d' = ordinates of curve 1 (Fig. 1). The following, therefore, are the values of d_p for points 5, 10, 15, 20 and 25 respectively.

Pt. 5 : 0.484 — 0.875 × 0.594 = —0.035
Pt. 10 : 0.875 — 0.875 × 1.000 = 0
Pt. 15 : 1.078 — 0.875 × 1.078 = 0.135
Pt. 20 : 1.000 — 0.875 × 0.875 = 0.234
Pt. 25 : 0.594 — 0.875 × 0.484 = 0.170

As the deflection under the load divided by the deflection under R_2 (point 20) gives the value of R_2, dividing the above ordinates by 0.234 (point 20), gives the ordinates for curve 5 of Fig. 4, which represents the influence line of R_2 of beam $R_1R_2R_3R_4$. Note that the positive ordinates are laid off below the

FIG. 4—ELASTIC-INFLUENCE LINES for beam $R_1R_2R_3R_4$.


Curve 5
Elastic curve of beam R1R2R4 loaded at point 20 = Influence line for R2 of beam R1R2R3R4
Curve 6
Elastic curve of beam R1R3R4 loaded at point 10 = Influence line for R2 of beam R1R2R3R4
Curve 7
Elastic curve of beam R2R3R4 loaded on the overhang at R2 = Influence line for R1 of beam R1R2R3R4
Curve 8
Elastic curve of beam R1R2R3 loaded on the overhang at R4 = Influence line for R4 of beam R1R2R3R4

base line and the negative ordinates above, to correspond to the direction of the deflections.

Curve 6 of Fig. 4 is the influence line for reaction R_3 of beam $R_1R_2R_3R_4$, and is obtained from symmetry by reversing the order of the ordinates of curve 5 of Fig. 4.

From the influence line given by curve 5 the reaction R_3 of beam $R_1R_2R_3R_4$ is known for the various positions of the traveling load. This reaction can be considered as a load on beam $R_1R_2R_4$, and the values of R_1 of beam $R_1R_2R_3R_4$ can be obtained from curve 3. For example, the condition for point 5 is illustrated in Fig. 5 where the value of $R_3 = -0.150$ was obtained from curve 5 (Fig. 4). Then, utilizing curve 3 (Fig. 1),

$R_1 = 0.437 - 0.250 \times 0.150 = 0.400$

For the unit load at point 15 the condition is shown in Fig. 6. Again, from curve 3 (Fig. 1) R_1 of beam $R_1R_2R_3R_4 = -0.219 + 0.250 \times 0.575 = -0.075$

Similarly, for point 25,

$-0.156 + 0.250 \times 0.725 = 0.025$

Thus, the values of R_1 for all the division points can be obtained and plotted as curve 7 of Fig. 4.

The above value of R_1 can also be obtained by considering the intermediate reactions R_2 and R_3 as acting on the simple beam R_1R_4, and utilizing the influence triangle for R_1 as given in Fig. 2. The reactions R_2 and R_3 are obtained from curves 5 and 6 of Fig. 4. A check on the values of R_2 and R_3 is supplied by a reciprocal interrelation of ordinates of successive influence lines as follows: for any two points, a and b of the beam, the reciprocal relations of ordinates can be expressed by the equation: $d_a'd_b^{VI} + d_a''d_b^{V} = d_b'd_a^{VI} + d_b''d_a^{V}$, where d_a', d_a'', d_a^{V} and d_a^{VI} denote the ordinates for point a of curves 1 and 2 (Fig. 1) and curves 5 and 6 (Fig. 4) respectively; and d_b', etc., denote the corresponding ordinates of point b. Computing the ordinates of point 8 by the process described above and using for the points a and b the two unsymmetrical points 8 and 25, we obtain:

Pt. 25 : $d_{25}' = 0.484$; $d_{25}'' = 0.594$; $d_{25}^{V} = 0.725$; $d_{25}^{VI} = -0.150$

Pt. 8 : $d_8' = 0.872$; $d_8'' = 0.736$; $d_8^{V} = -0.115$; $d_8^{VI} = 0.973$

Substituting the above values in the equation of interrelations:

$0.872 \times (-0.150) + 0.736 \times 0.725 = 0.484 \times 0.973 + 0.594 \times (-0.115) = -0.131 + 0.534 = 0.471 - 0.068 = 0.403 = 0.403$

The influence line for R_4 of beam $R_1R_2R_3R_4$ is given by curve 8 of Fig. 4 and is obtained from symmetry by reversing the order of the ordinates of curve 7. As a check, for every position of the unit load, $R_1+R_2+R_3+R_4 = 1$. For example, for a unit load at point 5: $0.400 + 0.725 - 0.150 + 0.025 = 1.000$.

Unsymmetrical spans

For unsymmetrical spans, the influence lines for the reactions can be obtained by applying the above procedure with but little additional labor. The elastic curve 2 would have to be calculated independently from a triangular distribution of loading as was done for curve 1. The other curves pertaining to the beam $R_1R_2R_4$ would be obtained by the same procedure. Curve 5 would be obtained by a process similar to the preceding. From the latter curve the reaction R_3 would be known for every position of the unit load; it could, therefore, be considered as a known load acting simultaneously with the corresponding unit load on the beam $R_1R_2R_4$. Each of the reactions R_1, R_2 and R_4 could then be obtained by the procedure outlined above in connection with the influence line for R_4 of the symmetrical beam $R_1R_2R_3R_4$.

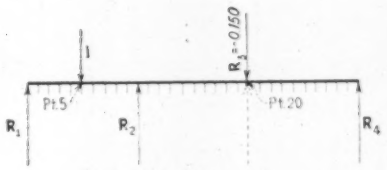


FIG. 5—METHOD OF LOADING of beam $R_1R_2R_4$ to obtain influence line for R_3 of beam $R_1R_2R_3R_4$.

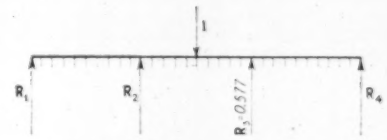


FIG. 6—THE REACTION R_3 produced by a traveling load on beam $R_1R_2R_4$ is regarded as a load, either downward (Fig. 5) or upward, as shown above, acting on the beam $R_1R_2R_4$.

Variable moment of inertia

In case the beam is of variable cross-section, the above method of obtaining the elastic curve for the simple beam R_1R_4, by using a triangular load distribution, would be inapplicable. Instead, the ordinates of a bending-moment triangle M corresponding to the various division points would have to be divided by the corresponding moments of inertia I. These quantities M/I, called "elastic loads," would then be considered as concentrated loads applied at the respective points of the beam R_1R_4. The bending-moment diagram produced by these assumed loads would be the elastic curve required. The remainder of the procedure would be identical with that employed in the above example.

Just as the influence lines of a two-span continuous beam can be utilized to derive the influence lines of a three-span beam, so can the influence lines of a three-span beam be used as auxiliaries for the influence lines of a four-span beam, etc. In each case the solution of a preceding stage of indeterminateness is made the basis for the solution of the succeeding stage.

The procedure outlined in this article lends itself readily to a graphical treatment, as was shown in the earlier article mentioned above. It is also in accord with the principle employed in modern methods of model study, so that it harmonizes the three methods of structural analysis—graphical, analytical and experimental.

Ten-Year Period of Omaha Water Statistics

COMPARATIVE waterworks statistics for 1923 and 1933 in Omaha indicate some startling results. In 1923 it required 3.32 tons of coal to pump a million gallons of water, and in 1930, the last year in which all water was pumped by coal, 23 per cent less coal was used. Curtailment of business of the railroads and manufacturing industries during the past four years has decreased the use of water over the peak year 1930 by more than a billion gallons a year. The averages in million gallons per day beginning in 1923 are as follows:

	m.g.d.		m.g.d.
1923	25.4	1929	27.5
1924	26.4	1930	29.0
1925	26.6	1931	28.1
1926	28.2	1932	25.7
1927	26.5	1933	26.2
1928	27.1		

The total cost of all pumpage in 1933 was $260,252, a reduction from 1923 of 23 per cent, but the cost of fuel and electric power at Florence, where the intakes, sedimentation basins and filtration plant are located, was $95,000 in 1933, a reduction of 36 per cent from the 1923 figures. The daily per-capita consumption in 1933 was 121 gal. Practically 100 per cent of the line services are metered, and 80 per cent of the consumption is accounted for by meters. The 1923 mileage of mains (412) has been increased by 129 miles, 31 per cent. Fire hydrants, gate valve and service increases have been 32, 31 and 26 per cent respectively. Bonds outstanding in 1923 ($6,892,000) have been reduced 25 per cent, but an additional $2,800,000 has been added in assets from earnings during the ten-year period.

The average cost per 1,000 gal. of water sold in 1933 was 3.39c. for pumpage, 1.08c. for distribution, 1.97c. for general expense, 3.07c. for bond interest, 6.36c. for reserves for sinking fund, depreciation and doubtful accounts, making a total of 15.87c. The income from all sources per 1,000 gal. sold was 15.91c. These figures come from a bulletin issued by Theodore A. Leisen, general manager, who has been in charge for the past ten-year period.

Ten Business Problems of Contracting

IX—Technical Hazards of the Job

Lack of business knowledge is the greatest hazard and is far more common than lack of technical knowledge—Technical hazards are unforeseen conditions, measurement of work, inspection and ambiguous specifications

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EVERY business activity involves hazards. It is rather commonly stated that contracting involves a somewhat larger number of them than other lines. Probably it does. Certainly the financial mortality among those who enter this field is so large as to suggest extra hazard. Its existence may, therefore, be admitted.

Perhaps it ought also to be remarked that contrary to a great deal that has been said and a great deal that has been written on this subject, the major hazards that contractors face lie in the business field rather than in the technical field. This is quite inevitable, for, regardless of its other aspects, contracting is a business. True enough, certain special knowledge is required. Still the fund of this special knowledge is small as compared with the fund of business knowledge it is desirable to have. It may be admitted readily enough that this special knowledge is a prerequisite to success. Obviously it is. But it is equally true that a knowledge of business affairs is a prerequisite to success. A failure to realize this essential fact underlies many an unfortunate adventure in this field. Indeed if those—both engineers and others—who have contemplated contracting as an activity had given themselves a thoroughly honest answer to the question "What do I know about business?" most of them would never have taken a single contract. So, at least to the writer, it seems that the greatest hazard in contracting today, as in the past, is the general failure among those who enter this field to realize that contracting is a business which must be conducted along sound business lines by men who understand business methods and business practices. For this reason, too, every man operating in this field today and every man who contemplates entering it ought frankly to consider the adequacy of his knowledge of business as business, and of the relation of contracting to other lines of business. In so far as his equipment here is deficient, continued success is likely to depend on the correction of this deficiency.

Many of the more important aspects of contracting as a business have been discussed in previous chapters. These discussions will not be repeated here except to remark that aside from the general risk that contracotrs face in any failure to realize that contracting is a business and to govern their conduct of it accordingly, very important risks are involved in the wide fluctuations that take place in the volume of business offered, in the general margin of profit at any time prevailing, in financing, in buying, in selling (bidding), in establishing policies and in managing personnel. All of these are phases of business, but the sum total of the hazards they involve is larger than the ordinary sum total of the technical hazards to which the rest of this article will be devoted. True enough, some of these business phases of contracting are part and parcel of the technical aspects of the contractors' activities. Still, by and large, they are business matters, and the hazards they present are common to all lines of business. Merely to mention them here should, therefore, be sufficient, for the discussions preceding this one have made their more important aspects reasonably clear.

Technical hazards

On the technical side of contracting, as on the business side, the greatest hazard faced by men now handling construction work and men who plan to enter this field is the very general lack of thoroughly adequate information as to the technical aspects of this work, and of the specific hazards such work involves. There are, of course, many individual exceptions to this observation —many contractors who are as fully familiar with the technical aspects of construction work as the best practicing engineers. The fact remains that a much larger number are not as fortunate as this.

At first thought this may not seem to involve an important hazard, but in practice it does, for any lack of technical knowledge leaves those who do not possess it much in the dark as to why things are done as they are and as to whether they might be done otherwise with propriety. Of necessity this restricts efforts to solve the new and the unusual problems which arise in the technical field, and in many of the more ordinary problems of construction it places the contractor at a definite disadvantage.

Another aspect of this matter is to be found in the fact that when the knowledge of either the business or the technical phases of his work is inadequate a contractor is apt to underrate the importance of the risks that specific projects involve. In doing this it is perfectly obvious that his own position as a contractor is endangered. But the effect does not end here, for, as noted in a previous article, every low bid has an influence on the market price for work of this character, so that the general tendency to underrate them shown by those who lack a full appreciation of the hazards involved tends to force contractors who understand these risks to disregard them in pricing work under penalty of obtaining no work at all if they do otherwise. The fact that so many contractors lack a broad knowledge of the fundamentals of business and of the technical aspects of construction work is not, then, a matter of importance solely to themselves. Rather, it becomes a matter of vital concern to everyone who handles construction work and to everyone who deals with contractors for, through its effect on prices and on margins of profit, it affects the stability of the whole industry and the hazard involved in any contact with it.

Unforeseen conditions

Taking up the specific technical hazards of contracting as distinct from the general hazards just noted, the one to which the greatest attention is given is the hazard involved in unforeseen physical conditions adversely affecting the cost of the work. These include such matters as uncharted subsurface structures, unexpected materials, unforeseen operating conditions caused by the nature of the materials encountered, etc. In theory, a contractor is presumed to make whatever examinations of the site of the work may be required in order to enable him to bid intelligently. In practice this is not done. There are several reasons for this, of which two will be mentioned.

The first of these is that well-established custom requires those who prepare the plans for specific undertakings to examine and report all important conditions that will affect the cost of their execution. As a matter of fact, engineers give so much attention to the care-

ful examination of all physical conditions likely to affect cost and report these conditions with such accuracy that contractors have come to accept such reports without much question. By so doing contractors pay the honesty and the integrity of engineers a well-deserved compliment. The great majority of the plans that engineers prepare deserve this compliment. Still, the fact remains that considerable risk is assumed at this point. With the best of intentions data that have been carefully collected can be erroneously interpreted. Mistakes occur. A few men are careless. In short, while the great majority of plans are accurate, a few are not. But the reliability with which most plans indicate working conditions appears to have caused contractors to expect all plans to be accurate. More attention might well be given to the hazard this attitude involves. It has been responsible for losses that could have been avoided.

A second reason that work is not examined more carefully before bids are entered is found in the fact that the cost of any really valuable investigation may be quite prohibitive. It costs hundreds—often thousands—of dollars to make a really reliable investigation of the underground conditions likely to influence the cost of even a moderately large bridge or a moderately large building. To gather such data for a structure of any size may cost a small fortune. The margin of profit that contracting provides is altogether insufficient to permit contractors to make such examinations as a preliminary to entering bids—a situation which on many classes of work forces contractors to accept the engineering plans at face value whether they wish to do so or not.

The contractor's position as a business man could be measurably improved by a little corrective legislation applied at this point. The legal doctrine that a contractor can examine the site of the work and apprise himself of all of the conditions likely to affect cost, after which he must accept full responsibility for the price offered, belongs to the Dark Ages. Doubtless it once was a sound doctrine. But that was a long time ago—before human beings took the trouble to build deep foundations, to run all sorts of services underground, to base many of their construction methods on the materials to be handled, and otherwise to make of construction a business of great complexity, quite unrelated to the work of designing the things to be constructed.

There is no need to go into this matter at length here. Suffice it to say that under the conditions today prevailing it is quite impracticable for contractors to make any such examination of the work on which they bid, if it is of much magnitude (and often this is equally true on work of ordinary magnitude) as the responsibilities assumed under the ordinary form of contract presumes them to have made. If a thing is impracticable, to say nothing of its being impossible, it should be legally set aside. Under present-day conditions most of the responsibility now placed on the contractor at this point belongs to the owner. In practice he has assumed most of it. But his assumption of it has been a matter of expedience rather than a matter of law. It should be made a matter of law. In other words, owners should be required by law to warrant the accuracy of the plans under which work is to be done, the purpose being to relieve contractors of a risk which the conditions of the work make it all but impossible to eliminate in any other way.

Measurement of work

Another type of risk, but one of no small consequence in the construction field, is encountered in the variability of the units used in measuring the work performed. Probably the most generally used and the most commonly encountered unit of measurement is the cubic yard of excavation. No unit with which the writer is familiar has a greater appearance of uniformity, and certainly none more completely lacks it. In practice, this seemingly stable unit usually (but not always, for measurement may be in final position) involves digging a cubic yard of some sort of material, moving it over a highly variable range of distances, and depositing it under an almost equally varied range of conditions. Still, excavation remains a matter solely of the number of cubic yards handled.

Some years ago the writer had occasion to study operations on a large grading job in the Southwest. All of this work was done by subcontract, the "subs" selecting the sections they wished to handle and negotiating a price with the general contractor. Two of these subcontracts were examined in some detail. On the first the agreed price was 20c. per cubic yard. On the second the agreed price was 22c. per cubic yard. A check-up showed that on the first section the dirt had to be moved an average of 375 ft.—on the second section an average of about 75 ft. Neither the contractor nor the subcontractor seemed to appreciate that as between these two sections a cubic yard of excavation was two very different things.

There is a great deal of just this sort of thing throughout the whole of the construction field. True enough, job to job differences in the actual magnitude of supposedly stable units are not often as great as they were in the case just noted. Still, the differences that occur with some frequency are quite large enough to cover all of the difference between a liberal profit and a serious loss. Nor do any of the units of which the writer knows avoid this situation. Some—as the pound of reinforcing steel—are more stable than others, as the square yard of concrete pavement, but none can be rated as stable.

Moreover, every change in specifications affects the significance of the units used in measuring the work done under it. When the engineers decide that all fills must be spread in 8-in. layers and each layer rolled, the significance of the cubic yard of excavation is altered. If a specification is adopted requiring that pavement be finished to a maximum variation of $\frac{1}{8}$ in. in 10 ft., the significance of the square yard of pavement is changed.

There is no need to extend this discussion of the units used in measuring construction work to justify the statement that the hazards encountered in this field are numerous and often of considerable magnitude. They can be avoided by giving specific jobs careful technical examination, for here the conditions that will govern are of such a nature that technical analysis will reveal their effect with a very satisfactory degree of accuracy. But such an examination requires no small fund of technical knowledge. It also involves time and expense. For this reason such analyses are not as generally made as would be desirable.

Again it is the writer's opinion that corrective action rather than more detailed examination of plans is the thing to be recommended. The risks that contractors now assume in this field, often taking them quite without any appreciation of their existence, could be considerably reduced by a more careful selection of the units specified, coupled with a sharp reduction of the scope of these units. As an illustration of the solution thus briefly outlined, take the case of excavation for highway work. In a region where the specified free-haul limit is 2,000 ft. the actual average haul for specific projects often will range from as little as 300 ft. to as much as 900 or 1,000 ft. The risk involved is considerable, for relatively few contractors check this detail. Indeed it may not be possible to check it, for the plans as they are regularly released do not always give the necessary information.

If, instead of a free-haul limit of 2,000 ft., the free-haul limit is reduced to 200 ft., any statement of the quantities involved, which as a matter of course must then include overhaul, will reveal the full significance, from the contractor's standpoint, of the difference between the job where the average haul is 300 ft. and the job where the average haul is 900 ft. A great deal of the technical hazard in construction work can be readily eliminated by careful and thoughtful work along this line.

Inspection

Inspection is widely rated as a serious hazard in all types of construction work. There is some warrant for this rating. Still, the general conception of this hazard exaggerates the importance of the phases of inspection which receive most attention, and at the same time it underrates the effect of certain phases

of inspection to which, as a rule, only casual attention is given.

The purpose of inspection is the protection of both the contractor and the owner by making, as it were, a continuous audit of matters affecting the quality of the work. Both the contractor and the owner are presumed to have agreed on the standards of quality that will govern. Either directly or indirectly these are defined in the specifications, and both parties have agreed to accept these definitions. This being the case, the running audit of quality known as inspection should have and, in the writer's experience, has had little effect on the contractor's operations as long as the quality of the work done has harmonized with the intent of the specifications. In the nature of the case perfectly honest differences of opinion will occasionally arise Sometimes the inspection is overexacting. In rather rare instances the difficulties are more serious. Admittedly there is a measure of hazard in all of these circumstances. Still, taken by and large, wherever there is a wholehearted desire to deliver the full measure of quality that the contract requires, the running audit of quality seldom involves any hazard and often protects the interests of the contractor quite as definitely as it protects the interests of the owner.

Where conflicts over the inspection arise which are, in fact, caused by a failure to provide the full measure of quality that has been agreed upon, it is, of course, quite improper to charge the resulting losses to the inspection. Their origin lies in the contractor's own organization. This is sometimes overlooked.

On the whole, then, inspection is not much of a hazard as long as it is confined to its normal field—the running audit of quality. But as construction has become more complex, more particularly as the processes by which the final result is to be secured have been developed to a point where considerable technical knowledge is required for their control, the field of inspection has been extended to include the control of operations which require technical control. Probably this would never have occurred had contractors sufficiently interested themselves in the technical aspects of those phases of their work in which quality is dependent on technical control. Be that as it may, since more thorough technical control is essential than was being provided, owners have entrusted this control to their inspectors. The result has been that on many types of work inspection has ceased to be merely a running audit of quality and, while still functioning with this as its objective, has taken over an increasing responsibility for the methods and the processes by which the desired quality is to be obtained. In theory this should create no greater hazard than was created by the older type of inspection. However, in practice, it does create this condition, for any control over methods tends to affect the efficiency of operation and, if this effect is adverse, the extra expense generated may be considerable.

Doubtless, in the long run the situation created by this expansion in the scope of inspectional authority will correct itself. However, in the recent past contractors have suffered no inconsiderable losses because the authority granted inspectors over methods and practices which affect quality has too often been placed in the hands of men who, while quite competent technically, did not fully appreciate the relation between methods, job production and unit costs.

The obvious solution is the selection, as inspectors, of men who have a keener appreciation of the effect their control over methods has on job results. However, until the necessity for the selection of such men is better understood and correspondingly greater care is used in this matter, contractors are likely to continue to find that inspection rather often is in the hands of men who know little of the problems that are involved in designing an efficient, well-balanced construction organization and operating it effectively. When this occurs, the solution lies in a thoroughgoing effort to apprise the inspector of the details of job management and of the effect the methods suggested for technical reasons may be expected to have on job performance. As a class, inspectors are reasonable men. Their objective is quality. This is altogether proper. They have no desire to destroy construction efficiency, and the great majority of them appreciate the fact that there is no necessary conflict between job efficiency and quality. This being the case, most of the hazard that lies in the broader authority now quite generally exercised by the inspection can be eliminated if contractors and inspectors will apprise each other of their objectives and definitely seek a mutually satisfactory solution of the problems that these objectives involve.

Ambiguous specification

A great many specifications use the phrase "to the satisfaction of the engineer," or one of equivalent meaning. This provision fell into disrepute in the days when it was freely used to protect favored contractors and eliminate those in disfavor. As construction has become more of an established business with a steadily decreasing tendency in most lines of work to handle it on any other basis, both the use and the abuse of this provision have been lessened. The hazard here arising has been correspondingly reduced.

Where properly used, the phrase "to the satisfaction of the engineer" usually means that if some other method, material or process than the one specified is used, the final result secured must be satisfactory to the engineer. Furthermore, it is presumed that the engineer will be satisfied if the results are equal to the results to be expected under the specified method or process. Viewed in this light, this phrase is an invitation to contractors to use other than specified methods wherever it is to their advantage to do so as long as the results are as satisfactory as the specified method would produce. Unfortunately, this point of view is not as widely understood as it should be, there being still some tendency among engineers to interpret this phrase as implying that when other than specified methods or processes are used, the standards of quality which are to govern are placed wholly within the discretion of the responsible engineer. This attitude has had the effect of restricting progress in a good many lines of construction work and occasionally has kept contractors from using processes advantageous to themselves which, while perfectly satisfactory, differed in detail from those specified. On the whole, the hazard thus introduced has not been great, for in such cases a reversion to specified methods always is possible.

Occasionally this phrase or one very similar to it is used to cover work it is not possible to define more accurately. In cases of this sort some hazard obviously exists. Still, under most circumstances, the fraction of any job that is covered in this way is small, and both contractors and engineers appreciate that the intention is a finished product the quality of which agrees with the general standard under which the job as a whole is performed.

Weather hazards

Weather is one of the greatest hazards that contractors face. Rain damages certain types of work. Cold damages some types. Wind damages and occasionally destroys others. All of these losses may, on occasion, be serious. However, most of them can be minimized by proper provision for the possibility that they may occur. Insurance can be made to cover some of them. While some are unavoidable in the long run, they do not constitute a major hazard if reasonable precautions are taken.

But the positive losses incident to weather conditions are small as compared to the indirect losses that weather conditions cause. These arise as a result of the effect of weather on the rate of production, that is on the efficiency with which production can be handled and on whether work can be done at all. This matter cannot be discussed at length here. Suffice it to say, therefore, that as construction is handled there usually are some men who must be paid even though no work at all is done. Often there are quite a number of men who are paid straight time. Equipment depreciation accrues whether the equipment is used or not. As a rule, there are other expenses to be met, to say nothing of the effect of delays on collections for ma-

terials when these must be incorporated in the work before they can be included in the monthly estimates.

The net result is that after construction starts there is a considerable accumulation of day-to-day expense which must be met even though no work is being done, with the result that whenever a job must be closed down on account of the weather, or for any other reason, the contractor suffers some loss, and often rather a serious one.

In addition to this, weather conditions are frequently responsible for reduced rates of production. The men work more slowly. Hauling equipment moves more slowly, and to move at all it must carry lighter loads. Other equipment may be more difficult to handle. In short, various conditions tend to reduce production with no corresponding reduction in personnel or in other operating costs.

For these reasons the weather hazard is considerable in most lines of construction activity and conspicuously high in some—particularly in highway construction. Nor can it be altogether avoided. Keeping the number of straight-time men to a minimum helps. It also helps to extend the period of delay after work has been stopped until substantially full efficiency can be secured when work is resumed. Still, some loss because of adverse weather conditions is to be expected on most construction jobs.

Nor does it appear to be possible to make due allowance for probable weather losses in pricing work. When competition is keen, too large a number of competitors are willing to speculate on the weather. It ought not to be done—but it is. Every one who reads this article will know of cases where a good profit was made on a job that should have netted a loss, merely because the contractor got a break on the weather. The number of instances in which there was a net loss in spite of a fair price, because weather conditions were adverse, is even larger. The weather is not controllable, and so long as contractors continue to speculate on it, results of this sort will be reported.

Finally, as to hazards in the construction field, it may be remarked again that increasingly contracting is a business that must be conducted along business lines. This implies a frank recognition of all known hazards, both of a business and technical nature, and due allowance for them in pricing work. True enough, prices cannot be set by the individual. As has been pointed out in a previous article, they are governed by conditions over which the individual contractor has little control. Still, as contracting becomes more definitely established as a business, its obvious hazard will receive more general recognition, and this will tend to increase their general influence on price.

Where the hazard that construction involves hinges on the interpretation of specifications and on the authority of the inspection, it cannot be too strongly urged that a generous exchange of ideas will eliminate most of it. When conclusions are reached—even if the conclusions involve a difference of opinion—they should be reduced to writing. After all, a contract is a written document. We pay this degree of respect—the respect of written statement—to all matters of importance. It should be paid to all transactions of consequence which bear on construction work.

Wisconsin Sanitation Stimulated Through Federal Activity

AIDED by the federal government, sanitation in Wisconsin is headed for an immediate development that ordinarily would have taken from three to five years to achieve. This is the opinion expressed by L. F. Warrick, state sanitary engineer, in his annual report for 1933. Eighty sanitation projects, totaling $16,000,000, are entered in the PWA program. Ten waterworks and seventeen sewerage projects and one combination project make up the $10,900,000 of projects approved to date in Washington. The values are about evenly divided between water and sewerage.

A total of 307 public water supplies now exist in the state, serving 1,767,000 people. The classification of supplies is as follows: 32 surface sources serve 957,000 people; 67 shallow wells and spring supplies serve 218,000; 17, using both shallow and deep wells, serve 73,000; and 190 from deep wells, serve 519,000. Sixteen of the surface supplies have purification plants, and only one is without treatment.

Cross-connection elimination continues. A total of 356 has been reported in 137 municipalities. Connections to non-portable supplies total 190, of which 88 have been given permits, 91 have been eliminated, and 11 are still unsatisfactory. Of 166 cross-sections with portable supplies, 124 are now reported under permit, 27 have been eliminated, 4 have permissions pending, 5 are unsatisfactory and 6 have inspections pending. Of 67 supplies listed by common carriers, 63 have been reported for favorable certification.

Newly installed iron-removal and softening plants at Evansville and Columbus have effected definite economies; reductions in hardness are from 20 and 17 grains per gallon to 4 and 3 grains respectively. Milwaukee and Two Rivers are ready to start construction on new filter plants.

The typhoid death rate was 0.56 per 100,000 population, an appreciable decrease from the 0.7 in 1932 and the lowest in the history of the state. None of the deaths came from water-borne typhoid.

The state has 218 cities with public sewerage systems, and sewage from 120 sewered municipalities is treated in 125 plants. New plants have recently been established at Fort Atkinson, New Richmond, Mayville, Edgerton and Marshfield. Separate sludge digestion with gas collection is provided in four of the plants. For the first time a school for operators was held at the University of Wisconsin with fifteen operators in attendance.

Industrial-waste control has occasioned 289 investigations. They have run mainly to stream-pollution abatement. Thirty-three cannery-waste treatment plants were in operation. To help the canners to secure good operating efficiencies, students desiring summer employment at the canneries were given preliminary training in control methods. Special studies of milk wastes indicate that proper trickling-filter systems are effective. Further improvements in a number of mills are needed to eliminate unnecessary pollution.

CWA men helped on fundamental studies of meat-packing wastes. In water-pollution control they also aided through determination of the factors influencing B.O.D. results obtained with certain trade wastes and the development of such modifications in analytical methods as are necessary to overcome the difficulties encountered, the establishment of stream-recreation values and summarization of data.

An All-Concrete Laboratory in England

The new physical and chemical laboratory of the Tunnel Portland Cement Co., Ltd., West Thurrock, Essex, according to an article in *The Engineer* (London), March 23, 1934, is constructed entirely of reinforced concrete, even to desks, shelves and cupboards. The building, 99x42 ft. in plan and one story, (about 13 ft. high) contains a slurry-testing room, curing room, a cement testing room, a chemical and physical laboratory room, and a room in which grinding machinery and testing machines are installed. Windows are continuous around the building and are sealed shut, a special ventilation and air washing plant keeping the atmosphere clear. Walls below the windows are precast units. The roof is of slab construction, lined on the underside with cork which, during pouring of the concrete, acted as the lower form. The building was designed by E. Owen Williams, consulting engineer, London.

New Bill to Attack Housing on a New and Wide Front

Modernization, construction and demolition of both homes and industrial structures, with federal guarantee of credit risk, form part of President's plan

Special Washington Correspondence

A HOUSING BILL written to his own specifications will be ready for President Roosevelt on his return to Washington. As outlined by the President these specifications propose:

(1) Modernization of existing houses that are worth the cost.

(2) Stimulation of new home construction that can be justified economically.

(3) Demolition of obsolete construction by discouraging repair of such structures and encouraging new construction.

(4) Repair and replacement of industrial structures.

In this program, as finally prepared by the National Emergency Council, modernization of existing homes is first in point of time, last in importance. To get this immediate phase of the plan under way, pending the more elaborate machinery required for its major features, the principle of consumer credit will be adapted to financing anything that "goes on the house," as it has been applied so successfully to practically everything that goes into the house.

Utilization of consumer credit, another name for installment buying, has shown a remarkably low loss ratio, even during the depression years. It is mortgages that have not paid out. To mobilize this credit for improvements to the home, a new type of credit instrument will be devised enabling the owner to combine in one operation all he can afford to pay for out of income during a period of one to five years.

Private loans, federal guarantee

Banks, finance companies, insurance companies and building and loan associations will be induced to make loans of $200 to $2,000 at 5 per cent through insurance by a government agency of the credit risk to an extent making it reasonably certain that they will incur no loss. The campaign set up along the lines of the war-time Liberty Loan drives will be entirely decentralized. Local architects and engineers will be enlisted and paid by the federal government to direct the program in each community. Their function will be to see that the home owner gets his money's worth and, alternatively, that the banks are not asked to loan more than the borrower can repay.

Estimates put the volume of needed home repair and modernization at $1,000,000,000 to $1,500,000,000. A guess is that possibly $750,000,000 to $1,000,000,000 may be turned up in the ensuing campaign by the end of the year. The figures have surprised the staff of the National Emergency Council who were skeptical regarding the volume of business that a modernization program might create. It still has to be proved out, as the scattered renovizing campaigns of recent years were not conspicuously successful. It is argued that these did not get far because their objective was not better housing but partook more of the nature of "buy now" and "share work" movements.

Housing also is the sole objective of the major program that will get under way after the repair and modernization campaign has been launched. If employment is created and the heavy industries stimulated, this will be gratifying, but in the program as outlined these benefits are regarded as secondary. The goal is to bring housing up to the production standards of other industries.

The President's plan does not propose outlay of a vast fund by the federal government as a subsidy soon dissipated by the high cost and inefficiency of present methods but the reorganization of home construction and home financing to bring adequate housing within the reach of people in the ordinary income range. Mass production at low cost, the trail blazed by the automobile industry, will be that which the home construction industry will be induced to follow, instead of constantly pushing up the cost of housing to figures beyond the reach of the mass market, as in the past. House builders and home financing institutions stand accused of selling to families of ordinary means not houses but debts that they could not possibly repay.

Present home construction and financial policies and practices would be made unprofitable by setting up competition responsive to popular need. Idle capital will be coaxed out of retreat and home financing institutions will be induced to lend by rediscounting mortgages through a central or possibly district agencies to be set up for the purpose, and insuring loans through a mutual mortgage insurance corporation under government direction and supervision in which all kinds of lending agencies can participate.

Single mortgage proposed

The practical effect of this plan is to eliminate second and third mortgages by combining them in one representing 80 per cent of the cost of the house at a net return to the lender of 5 per cent. A lower return to the investor is regarded as justified because the securities will ultimately have the backing of the government. By amortizing the loan over a perod of 18 or 20 years, the annual payments made by the home buyer will be equivalent to 9 per cent of the principal.

The insurance feature is believed to be all that is needed to give the liquidity required to the present mortgage market. It is argued by the administration's experts that with this inducement, existing agencies will have no reason for not resuming home financing operations. The administration is convinced that it is neither necessary nor desirable to set up its own financing agencies or to pour government funds into existing home finance channels.

To coordinate housing agencies

For essential coordination of the government's housing operations and contacts, the program calls for establishment of a unified federal agency comprising all existing agencies, the Home Owners Loan Corp., the Public Works Emergency Housing Corp., Federal Subsistence Homesteads Corp., the old U. S. Housing Corp., and other units born of the emergency or needed in the permanent program. The new agency may be simply a board or may involve the doubling up of some existing organizations. The bill prepared for submittal to Congress by the President creates the agency, with a provision for reporting back later the permanent form it is to take.

Some will not like the plan

The new plan will be disappointing to those who advocated that the government engage directly in home construction as another step toward state socialism. It will be equally disappointing to private institutions which said: Give us the money and we will build the houses. To the sluggish heavy industries it will not be as attractive as direct loans by the government for home construction.

Certain types of finance institutions and contractors are expected to resent overhauling of their methods. But the essence of the program is housing at low cost in large volume. To the administration this means not only the recovery of home construction and real property financing industries but their complete reorganization from the ground up. The administration has taken no pains to conceal its opinion of them as the country's two most inefficient industries. They may not enjoy the prospect, but now at least they know what to expect from the New Deal.

Heavy Road Construction in North Wales

Old Holyhead main road along the Welsh headlands being rebuilt with heavy sidehill cuts, tunnels and masonry viaducts

By F. G. Bailey
Thornton Heath, Surrey, England

A MODERN ROAD involving heavy cliffside construction is being built to replace the old Holyhead main road along the headlands of North Wales bordering the Irish Sea. The work in progress and illustrated here is at the rock point called Penyclip and is a part of the whole improvement traversing the headland. In general, the new road lies below the old road and above the tracks of the London, Midland & Scottish Railway to Holyhead, which includes the Chester-Holyhead railway and the Britannia Bridge built by Stephenson in 1845-1850.

Briefly, the existing highway is being relocated and changed over from a narrow road with steep gradients and supported somewhat precariously on the steep, and in parts unstable, hillside to a road with good width and easy gradients for the modern car, supported by heavy retaining walls, with rock tunnels and passing over a tall and massive viaduct running parallel with a smaller viaduct over which the railway to Holyhead passes. This railway viaduct has an engineering history of some interest by reason of the fact that when Stephenson was building the Chester-Holyhead railway he designed this part of the line with a most massive seawall, such as was built to protect other parts of the road. This seawall proved impracticable, and an arch viaduct was built.

Since the building of the railway the road authorities concerned, for long stretches along the North Wales coast, have been relieved of the anxiety and problem of sea-defense work, as the railway, by taking the outside berth and protecting its line from the sea, has automatically formed a first and safe line of defense for the public highway.

The railway viaduct that Stephenson built to replace the seawall was, however, a weak defense for the road and its adjacent area to the south of the line, as it allowed the sea to get through the arches, causing heavy erosion of the natural débris lying at the base of the cliff and consequent collapses of such magnitude that the road above was seriously affected. There are the remains of at least two collapsed roads, with at least one of which the famous Thomas Telford was associated when he built the Holyhead main road.

The other important factors calling for an improved road around the Penyclip point were the narrowness of the road and one particularly dangerous sharp bend. So far as the restricted width of the road is concerned, there is from the summit to the Llanfairfechan end of the work a stretch that is little more than 14 ft. wide in parts; this fact, coupled with the heavy gradient and unsatisfactory visibility, is the cause of serious dislocation of traffic at times. Frequently, and in the summer time especially, two wide vehicles get on to this section and cannot pass, and two queues of other vehicles accumulate behind; at times even mudguards have to be removed from these vehicles before the blockage cleared.

With regard to the actual construction of the work carried out up to the

CLIFFSIDE CUT between tunnels on new highway along North Wales seacoast. Route parallels Chester-Holyhead Railway, built by Stephenson, and replaces old main road built in parts by Telford.

HIGH VIADUCT on new Holyhead main road on North Wales coast.

present, there have been a number of unique features. Generally speaking, the new road runs between the existing road and the railway, and it has been necessary, and will be necessary throughout, to carry out the work in such a way that the existing highway above the new road shall not be affected adversely and also that the railway shall suffer no damage from the new road work above.

On sections where there is no blasting, as a safeguard to the railway, a protection fence consisting of heavy rails embedded in concrete and with a heavy wire-mesh reinforcement stretched over them has been placed to prevent materials of any sort falling onto the railway line from the work above, and, in addition, a railway watchman is retained during the principal working hours who can block the section in case of any accident. Blasting precautions are more elaborate, as, before any round is fired, the section has to be blocked in the customary way, and only when this has been done does the railway ganger hand over to the tunnel foreman a heavy brass disk marked "Fire the Shot." The railway company has also issued special regulations in regard to such blasting and has drawn the attention of the contractor's ganger and all concerned to the severe penalties entailed in any case of contravention of such regulations—the penalties including imprisonment for life.

An interesting discovery was made when the direct labor work was being carried out. While the hillside was being excavated back from the widening, some of the ground appeared to be running down into a hole. On further examination it was found that there was an old tunnel some 8 ft. wide by 8 ft. high running under the existing road which appeared to be a former means of moving granite from the hillside down to the sea or railway. The tunnel was built only with practically dry stone masonry, and the thickness from the intrados of the arch to the road surface was under 2½ ft. It was a remarkable instance of how old structures such as this hold together in spite of theory, inasmuch as modern main-road traffic, including heavy laden lorries, steam rollers, etc., had been constantly passing over this point. Immediately on discovery, the tunnel was temporarily strutted with heavy timber and was later filled by dry stone and concrete.

When completed, the road will have a 27-ft. carriageway, a 5-ft. footpath on the north side and a 2-ft. sloping verge on the south side. The last-mentioned verge is to ensure ample clearance in the case of vehicles with much overhanging width and to keep them from fouling the parapet wall when they are against the curb. It is formed as a slope to discourage pedestrians from using it as a footpath.

The consulting engineers are Howard Humphreys & Sons, to whom the writer is indebted for details.

Sewage-Plant Survey-II

Data from Cleveland, Ohio

THROUGH the use of coarse screens, grit chambers, Imhoff tanks and trickling filters the sewage received at Cleveland's southerly treatment plant is reduced in B.O.D. from 259 to 49 p.p.m. before it is discharged into the Cuyahoga River. The principal design characteristics of the plant and the average 1933 performance figures are shown below.

Sewage is received from only a part of the city, through a system of combined sewers. The plant was designed in 1926 by Geo. B. Gascoigne and Associates to care for a population of 240,000. The contributing population today is not accurately known, but the average flow received during 1933 was about two-thirds of the designed capacity. The cost of constructing the plant was about $3,000,000. Operation was begun in August, 1928.

The plant discharges treated sewage into the Cuyahoga River at a point about 12 miles from where it empties into Lake Erie. In the stretch below the plant outlet the river receives a great amount of untreated sewage and trade waste.

The coarse screens listed in the table consist of two sets of bar gratings set in tandem in each flow channel. The grit chambers are supplemented by a dry-weather flow channel. Each of the four chambers is provided with two grit sumps. Digested sludge from the Imhoff tanks is led either to the sludge-drying beds or to a sludge lagoon; of the 240 cu.ft. per m.g. of Imhoff sludge drawn from the tanks in 1933, 52.4 cu.ft. were sent to the drying beds. Flows tabulated were measured by a venturi meter. Analytical results refer to composite samples. Volatile solids are reported as per cent of dry solids.

The plant is under the management of G. E. Flower, superintendent. The tabulated figures were made available by J. W. Ellms, engineer of water purification and sewage disposal, who is in charge of all sewage-treatment plants in Cleveland.

SEWAGE-PLANT PERFORMANCE DATA, CLEVELAND, OHIO (SOUTHERLY PLANT)

GENERAL DATA

Rated capacity of plant, m.g.d.	30
Sewage flow	
Average m.g.d.	20.1
Maximum day, m.g.d.	43.5

SEWAGE-TREATMENT UNITS

Coarse Screens	
Number of units	4
Width of opening, in.	1½
Submerged area of screen, vertical projection, sq. ft.	415
Angle of screen with horizontal, deg.	45
Method of cleaning	manual
Grit Chambers	
Number of units	4
Plan dimensions, each unit, ft.	60x7
Operating depth, including grit space, ft.	9
Depth allotted to grit space, ft.	4½
Average flow to each unit, m.g.d.	12-24
Detention period, min.	1-2
Method of cleaning	clamshell bucket
Frequency of cleaning	monthly
Imhoff Tanks	
Number of units	12
Plan of dimensions, each unit, ft.	105x60
Settling compartment, each unit	
Surface area, each unit, sq. ft.	4,620
Depth to slot, ft.	11
Area of cross-section, sq. ft.	484
Sludge compartment, each unit, cu. ft.	40,800
Gas-vent area, each unit, sq. ft.	318
Sewage flow, all units, m.g.d.	20.1
Detention period, all units (actual flow), hours	3.6
Frequency of sludge removal, each unit	monthly
Trickling Filters	
Number of units	6
Plan dimensions, each unit, ft.	386x113
Sewage flow, all units, m.g.d.	20.1
Type of filter material	crushed limestone
Depth of filter material, ft.	10
Type of distributing system	spray nozzle
Type of underdrain system	vitrified block
Secondary Sedimentation Tanks	
Number of units	3
Plan dimensions, each unit, ft.	75x75
Operating depth, including sludge space, ft.	10.44
Depth allotted to sludge space, ft.	2.94
Provisions for sludge removal	diaphragm pumps
Sewage flow, all units, m.g.d.	20.1
Detention period at actual flow, all units, hr.	1.0

SLUDGE DISPOSAL

Sludge-Drying Beds	
Number of units	8
Length, each unit, ft.	227½
Width, each unit, ft.	18
Depth of sand, in.	12
Effective size of sand, mm.	0.2-0.3
Depth of sludge applied, in.	10

ANALYTICAL RESULTS

	Settleable Solids, (2 hr.), c.c. per liter	Suspended Solids, p.p.m.	Total Solids, p.p.m.	Five-Day B.O.D. p.p.m.
Raw sewage	3.1	312	921	259
Imhoff-tank effluent	0.1	121	696	161
Trickling-filter effluent	0.5	88	...	61
Secondary-tank effluent	0.2	57	614	49

SCREENINGS, GRIT AND SLUDGE

	Volume, Cu. Ft. Per M.G.	Dry Solids Per Cent	Volatile Solids Per Cent	pH	Disposal
Coarse screenings	1.3	...	...	....	Burial.
Grit	1.7	...	57.0	....	Burial.
Imhoff-tank sludge	240	8.4	43.8	6.8	To drying beds or lagoon.
Dried sludge	21	30.0	43.8	....	To farmers.

Seats in New Field House Salvaged from Old Stadium

Iowa University finds 100 per cent re-use value in eleven-year-old steel grandstands on abandoned athletic field

By B. J. Lambert
Head, Dept. of Civil Engineering, State University of Iowa, Iowa City, Iowa

AN UNUSUAL TYPE of CWA project has recently been completed at the University of Iowa, Iowa City, in which some steel bleacher seats erected around an outdoor field in 1922 were dismantled and re-erected in the new field house. The salvage value of the seats was practically 100 per cent, and only minor alterations had to be made to accommodate them to their new use.

The steel seats as originally erected on Iowa Field presented a novel type of construction, as they formed a 20-row upward extension of an existing reinforced-concrete stand 20 rows deep and 270 ft. long (*ENR*, Feb. 22, 1923, p.353.) Also 40 rows of steel seats were built at the south end of the concrete structures for a distance of about 70 ft. In all, some 10,000 steel seats were added, at a cost of about $50,000.

At the time the steel structure was built, emphasis was laid on its cheapness, adaptability and durability, and particularly on the ease of removal and re-use, should the occasion arise.

Several years ago the university built a new concrete depressed-bowl football stadium across the Iowa River, with a seating capacity of 42,000, at a cost of about $12 per seat. Since then the old grandstands have not been used. At about the same time a large field house was constructed, in which was placed the basketball court. The architects provided for some 8,000 seats of wood construction arranged in two balconies on each side of the floor, and also in a balcony extending across one end. In addition to these seats, there are some 4,000 or more temporary seats on the sides and one end.

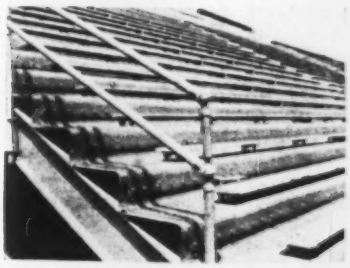
When the field house was constructed, the first balconies only were furnished with seats, but the demand for more room last year became so great that plans were made to complete all the seatings in the second balcony and also at the end. The CWA was hunting for hurry-up jobs, and the transfer of the old steel seats to the field house seemed to constitute an ideal type of work. The university furnished all materials, the CWA practically all the labor, and work was begun about the first of December, 1933, to dismantle and re-erect the old steel stands.

The dismantling was quickly accomplished by means of sledges, chisels and cutting torches, and the individual plates, each weighing some 800 lb., were hauled by truck to the field house. The supporting beams, as originally erected in the field house, were of variable spacing up to about 14 ft. The old ⅜-in. bent steel plates were about 17 ft. long, so that it was necessary to cut off some 3 ft. from a large number of plates. This was quickly done with a torch at a cutting rate of about 1½ ft. per minute.

The rise of the old steel seats was about 12 in. and the tread about 24 in. In the second balcony of the field house the slope was much greater, requiring a rise of about 17½ in. for a 24-in. tread. It was therefore necessary to extend the riser, and this was done by ¼-in. plates 8 in. wide attached by ½-in.-diameter bolts on 12-in. centers, using the old rivet holes in the original plates and new holes in the 8-in. plate, punched on the job.

In the first four weeks some 1,500 seats were placed, and in the next three weeks another 1,500, thus completing the second balconies on the north and south sides. The seat plates were arc-welded to the supporting girders, and the ends of the seat plates were continuously connected by an arc weld.

All seats were scraped and then steel-brushed, following which a coat of aluminum paint was applied on both upper and lower surfaces. The 8 x 1½-in. cypress seat planks from the old stands,



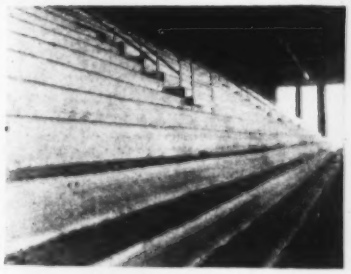
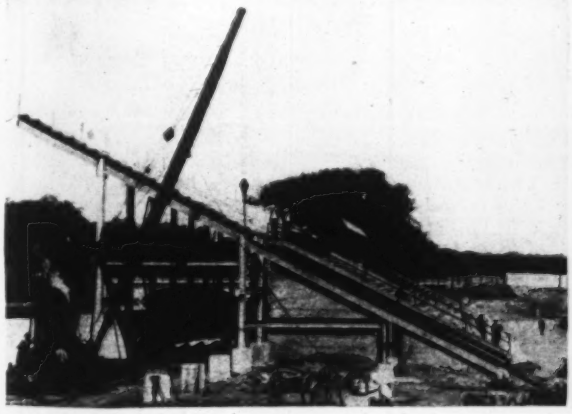


FIG. 2—DETAILS of seats as originally used in grandstand (above) and as re-used in field house, below. Bolts and welding replaced rivets, the bolts being required for a new plate that increased the height of the riser.



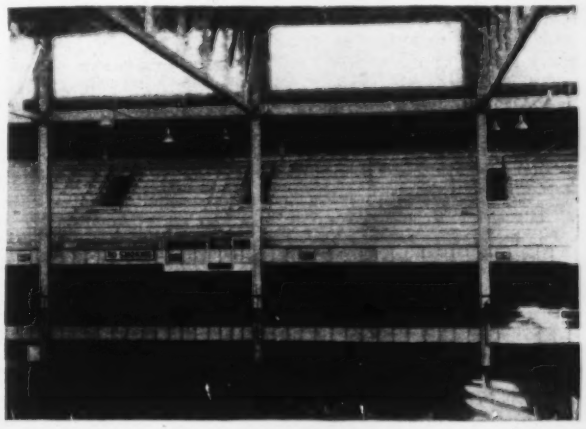


FIG. 1—STEEL STADIUM SEATS as they were being erected in 1922 (left) and as they appear in the second balcony of the field house to which they were transferred in 1933.

which were still in excellent condition, were then bolted to the steel plates. In the aisles adjacent to the vomitories auxiliary steps were installed so that the risers would be about 9 in.

Entrances to the second balcony are by means of steel stairs and platforms, made up almost entirely of structural steel plates and shapes from the old grandstands.

During the coming summer it is planned to dismantle the old wood seats in the first balconies and replace them with the steel seats. When the job is completed, there will be some 7,000 or more permanent steel seats surrounding the basketball floor. In addition, there are some 5,000 temporary wooden bleachers, including the seatings at both ends.

In the swimming-pool section of the building there is also a second balcony which will be supplied with some 800 steel seats from the same source.

Letters to the Editor

Venturi Meters for Sewage

Sir—Only a meager amount of information is publicly available on the possible corrosive action of raw sewage on the interior surface of venturi tubes. "The Effect of Sewage on Cast-Iron Venturi Meters," by C. E. Keefer, of Baltimore (*ENR*, Jan. 11, 1934, p. 46), therefore, is a contribution of importance. The periods of eleven to twenty-two years of continuous use are sufficiently long to be convincing. From the observed results it is logical to conclude that venturi tubes, if of high-quality iron with a proper protective coating, do not suffer appreciably in this service from corrosion. There is also ample support to the requirement that the throat be lined with bronze for entirely preventing corrosion or formation of scale, since it is this portion that is mainly responsible for the production of accurate differential pressures in relation to flow rates.

For the prevention of deposits of slime and grease, the venturi tube, when compared with straight pipe, possesses the advantage of sharp acceleration in velocity through the different sections. This may not be sufficient in certain kinds of sewage, however to prevent the gradual building up of deposits. For instance, Bayard F. Snow, *Sewage Works Journal*, September 1932, p. 853, describes the gradual but serious accumulation of deposits in two 30-in. venturi tubes, in main pipes and even in pumps, in the Salem-Peabody (Mass.) system, which carries a sewage particularly difficult to handle on account of the large proportion of industrial wastes.

All of this leads to another important phase of a subject upon which there is by no means general agreement among engineers. Putting it as a question: Should venturi tubes for sewage have a flat invert instead of true conical sections? Thus far there seems to be little actual data to support the requirement for the flat invert. Such tubes cost about a third more than the standard venturi design, due to their not being surfaces of revolution, hence requiring special patterns and foundry moulding. If sewage contains deposit-forming constituents, they will build up all around the interior, as Mr. Snow's report shows, no matter what the shape; if freely moving solids or sediment are present, deposition in a tube of standard conical shape is improbable due to the increased velocities. The only "low point" in the standard tube is near the inlet where there would have to be a relatively large deposition (improbable) before accuracy of measurement would be materially affected.

Generous hand-holes just beyond the throat or, still better, a "split section," the top half of which can be lifted off, exposing the interior of the tube for inspection and cleaning, are proper requirements for venturi tubes for sewage. Incidentally, Mr. Snow, in his paper, calls attention to the successful application of the split-section design in later installations for Peabody and Beverly.

It is hoped that there will be additional contributions from engineers and others on the subject of corrosion and flat inverts thus introduced.

CHAS. G. RICHARDSON,
Builders Iron Foundry

Providence, R. I.,
Jan. 27, 1934.

Deep Bridge Piers

Sir—In Mr. Jerman's article on the Atchafalaya River Bridge (*ENR*, Dec. 28, 1933, p. 776), particular stress was given the great depth to which some of the piers were carried, and justly so, because it is a wonderful piece of work.

It also brings into sharp contrast the design of the Southern Pacific bridge piers located less than 1,000 ft. away. These seven piers, 24x36 ft. in plan, were carried to a depth of 96 to 113 ft. below the water surface as against 176½ ft. at the state highway bridge. With the exception of the pivot piers these piers have a penetration of about 30 ft.

In one of the deep piers a set of antlers was found 5 or 6 ft. above where the cutting edge was stopped. In another a cypress stub was found. When the depth called for on the plans was reached, the "knees" of the stump were just beginning to appear. The stump was cut off level with the cutting edge and the pier sealed.

During the 27 years this bridge has been in use the piers have given no indication of having settled. Tests for bearing gave a value of 3 tons per sq. in. The spans were erected on the shore and floated into place.

A comparison of the costs of the two structures would be of interest to all bridge engineers.

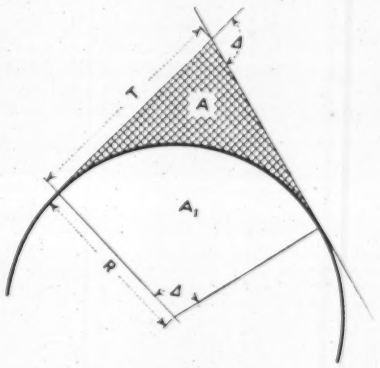
The piers were designed by E. H. Connors, vice-president and chief engineer of the Missouri Valley Bridge and Iron Co. The design was approved by D. K. Coburn, bridge engineer for the Southern Pacific Railway.

JEROME WILHELM.

Traverse City, Mich.,
Feb. 19, 1934.

Computing Paving Areas

Sir—On p. 17 of your issue of Jan. 4, 1934, I noticed an article by A. M. Weber entitled "Computing Paving Areas at Street Intersections." The method therein described appeared



rather backhanded and more complicated than necessary. I submit the following as an alternate method.

R = radius of curb return; T = tangent distance of curve; A = area desired; A_1 = area of sector of circle; and Δ = angle of intersection.

$$A + A_1 = RT$$

$$T = R \operatorname{Tan} \frac{\Delta}{2}$$

$$A + A_1 = R^2 \operatorname{Tan} \frac{\Delta}{2}$$

$$A_1 = \pi R^2 \frac{\Delta}{2\pi} = R^2 \frac{\Delta}{2}$$

$$A = R^2 \operatorname{Tan} \frac{\Delta}{2} - R^2 \frac{\Delta}{2}$$

$$A = R^2 \left(\operatorname{Tan} \frac{\Delta}{2} - \frac{\Delta}{2} \right)$$

where Δ is expressed in radians.

From this formula the area desired can be easily calculated, and if found

desirable, a table could be quickly made for various angles of intersection and various radii of curvature.

ROBERT MCKENZIE.

Missoula, Mont.,
Feb. 6, 1934.

Irregular Street Intersections

Sir—In *Engineering News-Record*, Aug. 9, 1917, p. 265, I described a method of determining the area of irregular street intersections. This method did not require the use of instruments for turning angles. The area between the tangents and arc of the street-corner returns was calculated without the value of Δ being known. A. M. Weber's article in the issue of Jan. 4, 1934, p. 17, simplifies my method greatly, as I determined the value of Δ and R from the fact that $T/E = C/2M = Q$, and $R = \frac{1}{2}(Q - 1/Q)T = \frac{1}{4}(Q + 1/Q)C$. By plotting a curve or preparing a table from

$$Q = \frac{\tan \Delta/2}{\text{exsec } \Delta/2}$$

it is then only necessary to measure the tangent and external distance or the long chord and middle ordinate, determine Q and from it Δ and R.

Combine the above with Mr. Weber's method, using Q in place of Δ. Then $K_1 = A/TE$ and $K_2 = A/CM$.

K_1 and K_2 may be directly calculated as follows:

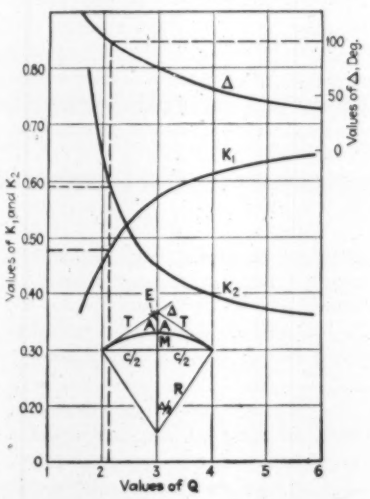
$$\text{Area } A = RT - \frac{\Delta}{360}\pi R^2 = K_1 TE =$$

$$R^2 \tan \Delta/2 - \frac{\Delta}{360}\pi R^2 =$$

$$K_1 R^2 \tan \Delta/2 \text{ exsec } \Delta/2$$

$$K_1 = \frac{\tan \Delta/2 - \dfrac{\Delta}{360}\pi}{\tan \Delta/2 \text{ exsec } \Delta/2}$$

CHART for determining values of constants K_1 and K_2 in calculating areas of irregular street intersections.



$$\text{and } K_2 = \frac{\tan \dfrac{\Delta}{2} - \dfrac{\Delta}{360}\pi}{2 \sin \Delta/2 \text{ vers } \Delta/2}$$

The accompanying diagram is constructed by using values of Q corresponding to Δ, plotted against K_1 and K_2.

It has been my experience that T and E are the most used in determining the area A, and these distances are also necessary in calculating other parts of the street-intersection area.

R. D. GLADDING,
Emergency Conservation Work Camp 60-P,
Hollister, N. C.
Feb. 1, 1934.

Tainter-Gate Discharge Formula

Sir: The article on "Discharge Coefficients for Tainter Gates" by Robert E. Horton (*ENR*, Jan. 4, 1934, p. 10) forms a valuable contribution to the information on this subject. The Koch-Carstanjen formula and Mr. Horton's

DISCHARGE COEFFICIENTS

No.	Ripley Observed C	Horton C	Koch-Carstanjen c_1	McMillan $c_1 = C$
1	0.76	0.738	0.716	0.719
2	0.73	0.723	0.702	0.703
3	0.70	0.707	0.687	0.688
4	0.71	0.689	0.669	0.669
5	0.68	0.667	0.648	0.649
6	0.67	0.646	0.627	0.630
7	0.60	0.618	0.600	0.607
8	0.56	0.587	0.570	0.583

rearrangement of it are involved in numerous terms and may be simplified. The family of curves are of the general form $\Theta = \left(X - \frac{Y}{N}\right)\left(\frac{1}{c_1^2} - 1\right)$ Evaluating and adjusting to conform as nearly as possible to the values taken from the diagram shown in the article, results in the formula

$$c_1 = \left[\frac{1.79\,N - 1}{\left(1.79 + \dfrac{\Theta}{22}\right)N - 1}\right]^{41}$$

in which N is the depth ratio $\frac{D}{w}$, D being the depth of water upstream from the gate and w the height the gate is raised, Θ is the angle of lip of gate to the horizontal, in degrees, and $c_1 = fC$, the coefficient in the formula $q = CA\sqrt{2gh}$ where q is the discharge in cubic feet per second, A the area of gate opening in square feet and h the actual or measured head above the center of the orifice.

This simplified formula is not mathematically equivalent to the formulas given in the article but gives results within 3 per cent, which is sufficiently accurate for practical applications. Comparison of the values given by the simplified formula with those shown in Table II of the article indicates the close conformation to the Koch-Carstanjen formula.

Table I of the article indicates that $C = 1.03c_1$, which factor Mr. Horton has used in his formula. In using the simplified formula I would recommend $C = c_1$.

W. BRUCE MCMILLAN,
Palo Alto, Calif., Consulting Engineer.
Jan. 15, 1934.

Symbols for Formulas

Sir—Can authors of technical and scientific books be prevailed upon to tabulate the letters which they use to designate various values in mathematical formulas at the beginning of the books? If this could be done, it would be a great help to those who use such books, and it would also be a great help if one letter with or without a subletter could be used throughout the book to designate the same item or value. If a uniform system of lettering could be adopted for mathematical formulas in all such books, it would be a further aid to the user. Some technical books have been published in which the lettering is tabulated in one place in the book, but in general this is not the case.

WALTER H. WHEELER,
Minneapolis, Minn. Consulting Engineer.
March 15, 1934.

Soil-Bearing Power

Sir—Your issue of March 15 contains an article, "Review of Soil-Bearing Test for Columbus Water Tanks" by Lieut.-Col. F. S. Besson, Corps of Engineers. Colonel Besson leaves out one point which, while perhaps extraneous to the direct theme, is not without significance.

Arithmetical, algebraic and geometric explanations in engineering discussions always lead somewhere, but practicalities also have a place. The case I have in mind is as follows:

A city contracted for filling an area that offered playground potentialities. It was an area through which an ancient stream had meandered in Revolutionary days. Moreover, the area was adjacent to the harbor of one of our most important maritime cities. Soil was placed over this "mushy" territory until somebody decided that the contractor was filling a chink between here and China. The work was stopped, and the contractor and those responsible in the city administration were held for legal inquiry.

Testimony proved that the soil had been placed; every yard of it that the contractor had charged for; but as it was deposited it displaced water in the "mushy" soil it was reducing to stability. Ergo, the water thus squeezed to the surface evaporated, and whatever space it formerly occupied disappeared. The defense was successful in maintaining its position on all counts, and so another supposititious "scandal" went into the discard. Thus practicalities are sometimes useful in solving engineering problems, when Euclid, Aristotle & Company are unable to explain the mystery.

GEORGE A. JOHNSON.
New York, N. Y., (Since deceased)
March 16, 1934.

ENGINEERING NEWS-RECORD

EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, W. G. Bowman, F. W. Herring, C. S. Hill, H. W. Richardson, J. I. Ballard, W. W. De Berard, N. A. Bowers.

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Tardy Vindication

A LETTER of the Federal Relief Administrator to C. E. Myers, of Philadelphia, clears Mr. Myers of the charge made three months ago when he was summarily removed from the position of consulting engineer of the CWA in Pennsylvania. Mr. Hopkins' sense of justice in making the correction is commendable, but it can hardly undo the injury done by the original charge and summary action. It is deeply regrettable that the past year's emergency activities have seen more than one public charge against engineers made in haste, without opportunity for defense, and in at least some cases under conditions that suggest injustice not unlike that done in Mr. Myers' case. The moral liability that government officials incur in actions that damage a citizen's reputation beyond repair is too grave to justify hasty, lightheaded action. The harm having once been done, however, elementary justice dictates that where fuller study of the facts shows the charge to be groundless the vindication should be prompt and as public as possible.

Municipal Luxuries

LINKING SLUMS AND LUXURIES together seems incongruous at first thought, but Howard W. Green in a notable analysis of a 300-acre area in Cleveland has just shown how logical it is. The area studied, with 2.5 per cent of Cleveland's population, accounts for 14.4 per cent of the maintenance cost of the fire department and 6.5 per cent of the cost of the police department. It returned in taxes only $225,000 but required $1,357,000 from the county, city and board of education and an additional $615,000 from the community fund. Thus $1,750,000 in excess of tax income, or nearly $80 per slum resident, is spent annually to keep some 20,000 of Cleveland's citizens in miserable and disease-ridden quarters. Social grounds have never been lacking to condemn city slums and argue for their removal, but to these there is now added proof of major economic advantage. Some of this apparent saving from slum eradiction may not actually develop, as for example a reduction in policing charges, since there is a question whether criminals now living in the slums would be any more law-abiding if quartered in modern housing. But even with policing eliminated, slum clearance would seem to be economically worth while. Taxpayers have been loudly articulate against all municipal luxuries, but so far they have not included slums among them. The Cleveland survey shows how wrong they have been.

Roadside Erosion

EROSION is one of the most irritating problems of the roadbuilder. Checking the scour of side ditches as described in this issue is an example, but the wash of shoulders and slopes is even more hazardous to travel and destructive of appearance. Within a single season, except for vigilant maintenance, slopes in friable soils can become a succession of gullies leading to a distorted channel where before was a shapely ditch. The destruction increases as the cuts deepen and the fills are higher. Fundamentally the cause lies in the common failure to design and construct all the roadway as carefully as the surfacing is designed. Wider right-of-way, stabilized soil shoulders, vegetation-bound slopes, top-of-slope diversion ditches in cuts, lip curbs and paved spillways down embankments are the correctives for erosion. In the best modern main-road design these are all considered, but more commonly they are neglected in construction and left to confound the maintenance engineer. At best, maintenance can be only a costly palliative; the remedy is correct roadway design and structure.

The Housing Revolution

IF THE INTENT of the housing bill that has been prepared for the President's consideration should ever become a reality, housing would indeed be projected into the revolution that has so long been predicted for it. For the bill, although directed immediately toward stimulation of modernization and repair, concentrates its most significant thrusts upon reform of financing practices. It sounds the death knell of second and third mortgages—at least that is claimed, and it may be sincerely hoped that the claims are not exaggerated. The bill also proposes a first-mortgage life consistent with the probable life of the property. This, coupled with sound amortization, would be a great improvement over the present practice of renewing mortgages every three to five years, with little consideration given to amortization. The new plan, as outlined on another page, contains a number of idealistic features whose accomplishment seems difficult. For example, mass production of housing at low cost can hardly be achieved by either fiat or wish, but the plan is realistic to the extent that it is designed to help private industry to help itself in reaching this much-sought-after goal. By guaranteeing the credit risk of loaning agencies, the plan removes one of the critical difficulties that have recently beset building finance. By coordinating and perhaps consolidating the various emergency housing agencies of the federal government, the plan helps to eliminate confusion and uncertainty. Instead of offering government funds as a gift, it extends a helping hand.

Pertinent Figures

DATA ON 1934 PROGRAMS for railroad grade-crossing elimination, collected by the American Institute of Steel Construction, indicate that less than 400 crossings will be improved this year. This is progress, but progress at snail's pace. All told, there are nearly a quarter-million railroad-highway grade-crossings in the United States, of which at least one in eight is important or dangerous enough to have some type of protection at present. At the rate of 400 eliminations in a year we would be long past 2000 A.D. before these most hazardous crossings are out of the way. Taking the good times with the bad, a more rapid program of elimination probably can be counted on, enough to reduce the date when all the existing first-class crossings will be wiped out to 1975. But, as the remoter crossings would steadily be moving over into the first class by population distribution and traffic growth, the situation would still be unsatisfactory. It would take two centuries more before all crossings were eliminated! This is not a pleasant prospect, for the present cost of grade-crossings is reflected in 1,500 to 2,000 deaths per year, two to three times as many

cases of injury, and operating costs of protected crossings that probably exceed ten to twenty millions of dollars yearly. Without a more aggressive prosecution of crossing improvement, the larger part of this cost is bound to remain a burden for generations to come.

Prices Trend Upward

RISING PRICES are forecast by developments in governmental action. It will be recalled that President Roosevelt, in addressing the Code Authority conference on March 5, made it a leading point to call for higher prices. Choosing his words carefully, he spoke of the minimum prices that will permit of increasing employment and wages; but industry's narrow margin between prime cost and selling price is too well recognized to permit of mistaking his real meaning. Already wages are increasing; the movement that began in the automobile and steel fields is spreading widely, through voluntary action, strikes and NRA dictation as in the coal field, where working hours also have been shortened to spread employment. And quite obviously this means an increase of prices. Indications are that the machinery of the NRA and auxiliary bodies, backed by the President's power to prescribe code terms, will be used to control this result. The plan to establish "consumer's councils" as a police force on prices strengthens this belief. Thus a general rising of commodity and material price levels may be looked for. A year ago, when prices rose because of the outlook for inflation, a broad wave of buying to stock up at low prices got under way. The present outlook makes a repetition of this movement not improbable, and, while last year this wave ebbed away by mid-summer, under the conditions of today there is a good chance that business activity will hold at the higher level.

Employment Prospects

CONFIRMING and extending its figures of two months ago, an estimate of public-works employment by the Public Works Administration gives the first definite yardstick of what Title II of the Recovery Act will accomplish. The estimate forecasts that the peak of employment will be reached during June to August, with some 800,000 men at work directly on the job. If this result materializes, the coming summer should see an employment total, direct and indirect, of two to three millions, for the men in mill, factory and transportation who constitute the services of supply multiply the direct job labor total by two or three. Beyond this working army, however, will be found a still larger number in the trade and business activities that result from repeated turnover of expenditure—from wage earner to retailer, wholesaler, and back to the factory; from mill to quarry. Even though the effect is less than last summer's outlook promised, and even though the slowness with which the program developed retarded the recovery movement seriously, it is likely to be this summer's strongest influence toward restoration of normal economic relations. But the same figures that forecast heavy summer employment also tell of progressive decrease in employment volume as next winter approaches. This fact, in conjunction with the exceedingly low total of 1934 construction—which represents only 40 per cent of our normal requirements—lays stress on the importance of plans for continuing the public-works compaign. The efforts being made to this end merit full engineering support.

Water Resources

INSTINCTIVELY, everyone knows that water is the nation's most valuable natural resource. At the same time it is least appreciated of all. When we come to factual appraisal of water resources, we find that they have never been subjected to fundamental study to determine a coordinated program of conservation and utilization for the greatest common good.

Because the control and development of water supplies falls within the province of the civil engineer forward-looking ideas should originate and crystallize in the profession. With the present initiation of long-range planning for the nation as a whole, consideration of water resources should be in the forefront, not only as a fruitful source of public-works projects but also as a means of ending the era of unplanned and uncoordinated development, which has already reached the point of impeding logical expansion in some sections.

Let us for the moment forget political boundaries and man-made divisions of administration, and instead look at the country's natural subdivisions—usually defined by its drainage areas. It will appear that each area is so vitally dependent on its water resources that the river system constitutes its dominating common interest. With rare exception also it will be seen that the possibilities of that system have been developed, if at all, from narrow viewpoints, without regard for the basic problems of the communities in the area. Even the most fundamental information is lacking from which these possibilities could be appraised — data on precipitation and percolation, on flow characteristics and the peak volumes that may need to be controlled and conserved, as well as on the factors that determine the balance of utilization for supply and waste disposal.

Essential streamflow data have been collected for years (principally by the United States Geological Survey) to the extent permitted by limited appropriations, but these provide no plan, no program, only the basis for sound study. The future development trends of the communities in any area, their relative rights to and their frequent abuse of the natural water resources, must be weighed and considered in respect to groundwater as well as the surface supply. Not only the obvious factors of how much population the water resources will support and how much runoff and sewage can be disposed of, but the immensely broader phases of regional planning for agriculture and industry need correlation. In those rare instances when a logical attack on the problem was attempted, the attack halted at the first hurdle of an imaginary political boundary line.

In the past, water-resource studies have been directed toward a particular purpose, such as navigation (the most ancient and now largely antiquated), municipal supply, power, irrigation, waste disposal or flood protection. The resulting program usually has been carried forward in disregard of other interests. Tolerable as this practice may have been in the country's youthful period of expansion and exploitation, it must now yield to realization of the hard fact that water supplies are definitely limited. Briefly, the nation has arrived at the point where its continued development is dependent on the planning and execution of a comprehensive program to utilize its water resources in the fullest way. Today, when we are in the beginning of the first broad enterprise of national planning ever attempted, we have an opportunity to recognize this fact by making the study of water a cornerstone of the enterprise.

CURRENT NEWS

Authority Issues First Certificate to General Contractor

CERTIFICATE No. 1 was issued by the Construction Code Authority, April 5, on an application presented through the Divisional Code Authority for General Contractors. This application was from the W. E. Wood Company, Detroit, Mich., and the project was a second story addition to the power house at Marygrove College reported to cost less than $10,000.

On March 21, the Administrator granted a stay against the application of the construction code so far as it applies to the members of the Land Development and Home Building Industry, pending the approval of the Code of Fair Competition for Home Builders. However, during the period of the stay, members of the last named group will be required to comply with the wage, hour and general labor provisions of the construction code.

A separate Code for Home Builders was proposed last September as one division of the Real Estate Code. It was sponsored by the Land Development and Home Building branch of the National Association of Real Estate Boards. This group conferred extensively with the members of the Construction Industry Code Committees last fall, and at the time a separate building code was proposed by sponsors outside the Construction League Code Committee, it was thought that the Home Builders would assent to the Construction Code and file their proposed Code as a part of the Construction Code.

However, they claim that there is a closer relationship between their group and the real estate group than with the various branches of the construction industry. A draft of their code has not yet been accepted for public hearing, the matter of definition being the particular point at issue, since it is understood that the differentiation of home building under this separate code from other home building must be made on the basis of large tract development. Moreover, it is probable that the construction operations, even under this separate code, would be governed by the construction code.

The Controller General of the United States has approved the provisions of the Executive Order of Mar. 14, which requires all bidders on government contracts to sign a certificate of compliance, indicating that they are complying, and will continue to comply with the provisions of the applicable codes of fair competition. The PWA is revising form No. 61 to meet the new requirements. It is reported also that the Treasury Department is preparing a procedure under this Executive Order.

On April 6, NRA Compliance Division issued instructions to the state compliance directors cc cerning the construction code. These directors were warned against assuming the authority to establish local administrative committees, bid depositories, or other matters to be covered by the industry's self-government.

Two New Parkway Authorities Created for New York City

During the past week Governor Lehman, of New York, has signed bills creating two different parkway authorities, to operate within New York City in a manner similar to that already adopted for the Triborough Bridge Authority. In each case the Authority will be provided with powers to construct the parkway on lands, parks and streets in the city of New York and to maintain, operate and charge tolls for the use of all or part of the project.

The Henry Hudson Parkway Authority is authorized to construct a parkway extending generally from the north end of Riverside Drive through Inwood Hill Park across the Harlem River ship canal, and through Van Cortlandt Park. A bridge across the ship canal and other incidental bridges and viaducts are included.

The Marine Parkway Authority is authorized to construct a parkway through Marine Park in the Borough of Brooklyn across the waters of Rockaway Inlet and through Jacob Riis Park in the Borough of Queens. This Authority is also authorized to develop and construct recreational facilities in the park on a plan similar to that utilized by the Long Island State Park Commission at Jones Beach. Robert Moses, city park commissioner and head of th Long Island State Park Commission, it i understood, will direct the work. Bot bills are worded so that the commissione of parks of the city of New York may constitute the Authority or shall be a membe of it if it is to consist of more than one member.

Bids for 1,500,000 Barrels of Cement for Boulder Dam

Three bids were opened on Mar. 26 for 1,500,000 barrels of cement to be used in carrying forward the concreting operations on Boulder Dam. The bids are now in the Washington office of the Bureau of Reclamation awaiting final study and approval.

The lowest bid was submitted by the Union Portland Cement Co., Devil Slide, Utah, at a figure of $1.26 per barrel.

The next lowest bid was a joint offer submitted by four California companies with headquarters in Los Angeles: Southwest Portland Cement Co., California Portland Cement Co., Riverside Cement Co. and Monolith Portland Cement Co. at $1.49 per barrel.

The other bid, of the Calaveras Portland Cement Co., San Francisco, Calif., was $1.55 per barrel.

New York State Planning Board Meets and Outlines Program for Study

AS THE RESULT of an initial two-day session, the New York State Planning Board, recently appointed by Governor Lehman, adopted a program for immediate work. Its force of 38 CWA employees will begin work immediately on a general survey of:

(1) Trends and tendencies, such as population shifts, migrations in agriculture and changes in proportion of occupational groups;

(2) Rural land utilization, including abandonment of farms, establishment of subsistence farms, reforestation, and the utilization of unused areas for recreational or game production purposes;

(3) Transportation, including the planning of main highways, farm to market roads, trucking routes, canals and water transport and air transport;

(4) Water problems, including the proper supplies for large metropolitan centers, purification of sources and the problem of flood control in relation to soil erosion, swamp drainage and water storage;

(5) Power production and distribution and industrial location;

(6) Suburban trend;

(7) Stranded populations;

(8) Development of a general plan of permanent public improvements, including state institutions, highways, parkways, bridges, canals, etc.

Presided over by Provost A. R. R. Mann, Cornell University, chairman, the board obtained information from various state departments. Reports on the progress of work under way and the contemplated programs for the next ten years were submitted by the heads of the departments of public works, conservation, health and budget. At a future session similar reports will be received from the departments of social welfare, mental hygiene, agriculture and education. The board learned that a large amount of state planning had already been done, and that much of the board's duty would be to coordinate the various planning activities of the state departments and agencies, as well as the work of the subordinate divisions of the state, including the regional planning that has been done for the metropolitan area of New York City.

Two of the most important immediate activities of the board will be the assembling of population statistics and an intensive study of land utilization. It was the opinion of the board that these factors of population decline or shift and land abandonment were of particular importance and should be studied intensively with a view of recommending to the legislature, at the earliest possible moment, some plans for the utilizing of abandoned land and the economic accommodation of the shifting population.

Robert Whitten, consultant, assigned by the Federal Planning Board, was authorized to proceed with the general survey program, with particular emphasis on the two subjects mentioned. The 38 employees of the board have been paid out of CWA funds up to the first of April and will continue on funds provided by the FERA.

Floods in Wisconsin Wash Out Bridges and Dams

HEAVY RAINS on snow and frozen ground resulted in severe floods in northwestern Wisconsin on the tributaries of the Chippewa river. The damage is estimated to approach $3,000,000 and includes highway bridges, small dams and private property in the vicinity of the towns of Hudson, Menomonie and Chippewa Falls.

A brief preliminary telegraphic report received from Charles A. Halbert, state chief engineer of Wisconsin, provides the following information: About 2 to 2½ in. of rain, preceded by heavy snows on frozen ground on April 2-3 in the northwest part of the state resulted in floods on many of the smaller streams which probably established new high records. The principal damage occurred in the eleven counties in this part of the state centering on Dunn, Barron, St. Croix and Chippewa counties. From ten to fifteen dams on the smaller tributaries of the St. Croix and Chippewa rivers with heights ranging from 10 to 25 ft. were seriously damaged. Th· dams were located on branches with drainage areas from 25 to 250 sq.mi. The most common type of failure resulted from the washing out of embankments caused by the high runoff. Reports indicate that from 20 to 25 bridges on the state trunk highway system were washed out or damaged and that a greater number of bridge structures were destroyed on secondary roads. Total flood damage to both public and private property is estimated at from 2 to 3 million dollars.

Conditions were particularly favorable for a high runoff with a concentrated rainfall within a 12 to 20 hour period falling on frozen, snow-covered ground. The heavy runoff, however, was principally localized in the smaller tributaries and the high water on the larger rivers, including the main Chippewa and Mississippi rivers, was materially below the existing record.

Reports from other sources indicate that the rush of water resulting from the washing out of some of these small dams swept away a fish hatchery and broke the gas main connecting Hudson with Stillwater, Minn. Water supply connections to the small town of North Hudson were also broken. The water plant at Menomonie was reported under water for a period of time with the pumps shut down. No reports indicate that the major storage dams on the larger streams were damaged by the high water.

Other floods

A sudden flood on the Washita river in Oklahoma, April 4, resulted in the death of several persons living in the flood channel of the stream. In several cases it is reported houses were entirely swept away by the sudden rush of water.

The annual break-up of ice on the Grand river near Montreal, Canada, is reported to have formed jams and floods which threatened several bridges below Grand Valley near the town of Elora. The Grand River, according to reports, rose 10 ft. during one night. No particular difficulty was expected unless complications developed as the result of serious ice jams.

Ohio PWA Employment Will Reach 20,000 Peak in September

A peak employment of 20,000 men on Ohio PWA projects will be reached about September 1 of this year, according to an estimate made by the state PWA organization. At that time practically all of the PWA projects will be under contract and most of them in active operation. This employment estimate includes only those working on the jobs directly, and not those indirectly employed on supplying materials and equipment. Further, it is estimated that about 1,000 engineers, architects and draftsmen are now at work on these projects, and that this number will be almost doubled by late in the summer.

Court Ruling Asked for on Columbus Sewage Plant

The question of whether construction of a sewage treatment plant is subject to a referendum has been submitted to the Ohio supreme court by the city of Columbus. The city is under orders of the state health department to discontinue pollution of the Scioto river, and plans have been prepared for the construction of an activated-sludge plant. The PWA has approved a loan and grant to finance the $3,400,000 project.

A petition has recently been filed calling for a referendum on the proposed project. The city service director, William J. Lucks, has stated that the taking of bids on the plant has been postponed until the court decides whether such a referendum is required.

In filing its action in the supreme court, the city seeks to avoid the delay which would ensue if action were filed in lower courts. The city is now faced with an alternative write of mandamus in the supreme court, ordering it to proceed at once on the plant construction in accordance with the state health department's orders.

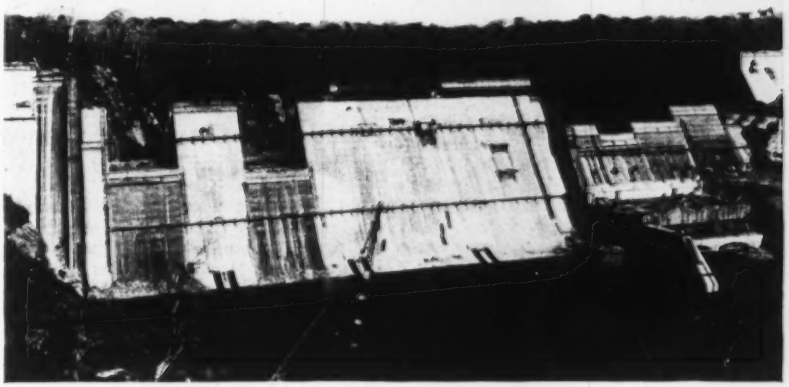
Rock Slide on Main Highway Kills Three in New York

Crashing down from the side of Storm King Mountain, several tons of earth and boulders, loosened by frost and spring rain, struck the important Storm King Highway near West Point, N. Y., wrecking several automobiles, killing three people and injuring several others. The slide occurred on Sunday afternoon, April 8, when the highway was crowded with traffic, and about three hours were required to clear the roadway.

This highway is cut out of the mountain side about 400 ft. above the Hudson River. The slide started on the steep mountain side above the highway and moved down to a more gradual slope where the loose earth stopped but the individual boulders continued on down the mountain and crashed onto the highway. One boulder weighing almost a ton struck directly on top of a passing car, killing the occupants of the back seat, and then continued on breaking through the stone retaining wall on the opposite side of the highway.

Municipal Tax on Flooded Land Authorized by Canadian Court

Land flooded by artificial raising of the water surface of a river does not render such land exempt from municipal taxation, according to a decision handed down by the court of King's Bench, Appeal Side, Montreal. The judgment partly maintains an appeal made by the town of Laval des Rapides (adjacent to the Island of Montreal) in a previous judgment over land owned by the Montreal Island Power Co., along the Back River, flooded by the construction of the Back River water-power project. The court, based on a majority opinion of 2 to 1, held that the flooded land possessed value more or less equal to that it had held prior to flooding and could be taxed.



MADDEN DAM PROGRESS REACHES CREST LINE

Construction progress on the 220-ft. Madden dam, in the Panama Canal Zone, has progressed to topping out the crest in some of the sections as shown in this progress picture taken March 21. This structure will store 500,000 acre-ft. to augment the water supply for the operation of the Panama Canal. The dam is about 900 ft. long and includes a 436-ft. spillway section in the center, as indicated in the picture, and includes a hydroelectric power-plant installation on the righthand end. The structure will contain about 500,000 cu.yd. of concrete. The general project was described *Engineering News-Record*, July 30, 1931, p. 162, spillway tests, July 14, 1932, p. 42, and the concreting plant, Dec. 8, 1932, p. 167.

C. E. Myers Exonerated by CWA Following Summary Dismissal

Clarence E. Myers, consulting engineer, Philadelphia, summarily dismissed three months ago as advisory engineer to the Civil Works Administration in Pennsylvania, has been completely exonerated by Harry Hopkins, Federal Civil Works Administrator, of the charges then brought against him.

Mr. Myers was dismissed on Jan. 19 on the charge of having accepted a fee on a civil works project. It was charged that in connection with a $45,000 sewer project in the borough of Kennett Square, Pa., he had accepted a fee of $3,000 from the borough for consulting services while engaged in an advisory capacity to the CWA.

Mr. Hopkins, in a letter to Mr. Myers dated April 7, states: "Since writing you last I have caused a further investigation to be made into the CWA sewer project in the Borough of Kennett Square, Pa. This investigation, I am pleased to say, discloses that no fee was paid to you in connection with this project. Also, I have been told, and I have no reason to doubt the veracity of such statement, that no fee was expected by you, and that there was no intention on the part of the Council of the Borough to pay any fee in connection with this particular project."

Chicago Planning Conference Covers Wide Range of Topics

At the eleventh annual meeting of the Chicago Regional Planning Association, April 6, Prof. C. E. Merriam, member of the National Planning Board, outlined the aims of that body; John W. Kapp, member of the Illinois State Planning Commission, reviewed the program and accomplishments of the CWA staff; and Robert Kingery, director of the Chicago Regional Planning Association, discussed the association's activities for the past year.

The Chicago regional area has been extended at the request of Milwaukee County, Wis., and South Bend, Ind. The new territory includes 250 cities and villages. The main accomplishment has been the work of the ten CCC units working on flood control and lagoons in the Skokie Marsh and five others on 1500 acres of "forgotten" land available for forest preserve along the old Illinois and Michigan Canal. Mr. Kingery pointed out that this large concentration of CCC units had been possible because previous plans were available.

Future plans for a state highway system in Illinois have been coordinated with those in Indiana and Wisconsin. Illinois has a $9,000,000 program soon to be under construction. Indiana has a $1,500,000 development and Wisconsin a $500,000 plan, all within the region.

Zoning has progressed from 37 cities, when the association started, to 84, containing 93 per cent of the population. DuPage County, without any law, has zoned its area by resolution following a land-use survey. The program is working by persuasion rather than compulsion, but eventually the legislature will be asked to set up a county zoning law.

Daniel H. Burnham and Mr. Kingery were reelected president and secretary respectively.

FERA Program Exceeds Estimated Cost of $75,000,000 per Month

Current allotments by the Federal Emergency Relief Administration exceed by $5,000,000 to $15,000,000 a month the cost estimate of $75,000,000 per month made by Administrator Hopkins when the CWA program was converted into the Emergency Works Administration April 1. The CWA cost the federal government an average of $50,000,000 a week. Direct relief during that period dropped to $25,000,000 or $30,000,000 a month as CWA employed an average of 3,000,000 and reached a peak of 4,000,000.

About 1,953,000 remained on CWA payrolls at its termination and, according to Administrator Hopkins, substantially this number was transferred to EWA rolls. Prior to that time, however, 2,000,000 had been dismissed from CWA and Hopkins attributes the excess of current disbursements over his estimate to the number of people who need relief and the inability of local EWA organizations to investigate the individual cases in which need, the basis for obtaining an EWA job, is claimed. To ease the transition period it is necessary to give applicants the benefit of the doubt and the administrator describes his immediate problem as determining the size and trend of relief requirements. State relief administrators have been requested to submit estimates of the number of people on relief, including EWA, with an accurate count to follow.

Oskar von Miller, Founder of Technical Museum, Dies

Dr. Oskar von Miller, founder of the famous Deutsches Museum, Munich, Germany, pioneer in the field of water-power engineering and friend of Thomas A. Edison, died in Munich, April 9, aged 78. From 1880 to about 1900 he was active in the field of hydro-electric power development, being a director of the German Edison Co. He will be remembered among engineers as the founder of the original technical museum in Munich in 1903. It was started in 1909, but because of the war interruption was not completed until 1925. This famous museum, reflecting the march of science and engineering, has since been copied in several cities, particularly in the similar institution in Chicago.

Grand Coulee Dam Bids Expected To Be Called by April 15

As a result of a meeting of the consulting board on the Grand Coulee project and the representatives of the Columbia Basin Commission in Denver, decisions have been reached indicating that the bureau of reclamation will call for bids on the main contract by April 15. The project consists of a dam and power development on the Columbia River about 80 miles west of Spokane, Wash. The structure will be built by the U. S. Bureau of Reclamation and financed as a Federal PWA development. The estimated cost for the present project is $63,000,000, with the final cost probably exceeding three times that sum.

According to present plans, work on the dam would start June 1 and October, 1937 would be the completion date. Bids will be opened in Spokane about May 15. Five syndicates of contractors, including one headed by David H. Ryan, contractor for the preliminary excavations, are expected to submit bids. The tentative construction program follows: start of river diversion June 1, 1934, main excavation work Oct. 1, 1934, beginning of concreting on dam September, 1935, and completion of dam October, 1937. The dam will be 246 ft. high above bedrock and 183 ft. above river level. More than 3,000,000 cubic yards of concrete will be required.

The Western Construction Co., of Seattle, has been awarded the contract for the construction of two center piers of the cantilever bridge across the Columbia River downstream from the damsite.

New York Building Contractors Form Two New Organizations

In preparation for operation under the construction code, building contractors of New York City have organized two new groups. One of these, the Metropolitan Builders' Association, is made up of the larger contracting firms, many of them operating on a nation-wide basis. The other group, known as the Building Contractors Employers Association, Inc., embraces the smaller building contractors. The two organizations will cooperate, and both have applied to the deputy NRA administrator for the right to represent their respective classes of contractors. Officers of the Metropolitan group are: president, H. C. Turner, Turner Const. Co.; vice-president, P. S. Vermilya, Marc Eidlitz & Son, Inc.; vice-president, J. W. Escher, White Const. Co.; treasurer, W. J. Barney, Barney-Ahlers Const. Corp.; secretary pro tem, D. T. Webster, Marc Eidlitz & Son, Inc. Organization of the Building Contractors Association is as follows: president, J. S. O'Connell, J. Odell Whitenack, Inc.; vice-president, H. M. Weitzner, Henry M. Weitzner, Inc.; vice-president, J. Schlesinger, Jacob Schlesinger, Inc.; treasurer, S. W. Newman, Wildman & Newman, Inc.

Out-of-State Contractors Tax Not a Federal Legal Issue

Validity of a license tax imposed by the Virginia Corporation Commission on an out-of-state contractor building a post office building at Lynchburg is upheld because the United States Supreme Court had declined to rule on the question. The court dismissed an appeal brought to set aside the tax, holding that it did not present a substantial federal question, according to report.

The Supreme Court of Appeals of Virginia had previously upheld the trial court in declaring the tax valid, holding that it was impossible for construction operations to be carried on entirely on government property. It was pointed out that the contractor would of necessity have to use the streets and nearby sidewalks under permits granted by the city. The contract is held by Ralph Sollitt & Sons Construction Co., an Illinois corporation, with the majority of the actual construction operations on the post office building carried on under sub-contracts. The company contested the contractor's license tax of $250, challenging the authority of the state to tax a federal activity or to extend its jurisdiction over federal property.

PWA Announces More Financing Available From Rescissions

ALLOTMENTS for additional non-federal construction projects have been announced by the PWA as the result of rescinding loans which, for various reasons, have not been accepted or have been too long deferred. These funds are being reallotted to projects left on the waiting list when the $3,300,000,000 of PWA financing was exhausted. Most of the rescissions have resulted from the recipients of the original allotments being unable to proceed with the planned improvements or deciding to finance them from other sources. The list of new allotments for non-federal projects just released is given in the accompanying table.

Among the more important non-federal projects which have been taken from the list recently are the $658,000 loan and grant to Fargo, N. D., for sewer construction and a disposal plant, a $407,000 loan and grant to Hagerstown, Md., for a hospital, a $906,000 loan and grant to Omaha, Neb., for storm sewers, and a $177,000 loan and grant to Franklin, La., for sewers and a disposal plant.

Another source of PWA financing, since the exhaustion of the original fund, results from requests of municipalities to have their loans-and-grants reduced to 30 per cent grants because of arranging to secure additional financing from other sources. As fast as this source of refinancing is available to the PWA, it is reallotted to those projects on the waiting list. This situation has developed rapidly and a recent announcement indicates that the recipients of 22 allotments for loans and grants have requested that these be reduced to grants. Of these projects, 16 are in the state of Massachusetts, 3 in Kansas, 2 in Missouri, and one in New Hampshire. The largest change resulted from the request of Boston, Mass., to have four original loans and grants totalling $4,850,000 reduced to grants totaling about $1,350,000. The changes in these 22 allotments, alone, result in releasing $6,324,000 for further non-federal projects.

An allotment of $40,000 to the U. S. Coast and Geodetic Survey for conducting studies to determine the relation between seismic ground movement and the resulting stresses in buildings has been announced by the PWA.

Dayton Morgan Engineering Company is Reorganized

Occasioned by the resignation of Arthur E. Morgan, now chairman of the Tennessee Valley Authority, the Dayton Morgan Engineering Co., Dayton, Ohio, has effected changes in its organization. C. C. Chambers has been elected president of the company and Carl A. Bock, vice-president, will continue inactively in the same position. The location of the company's office in Dayton, Ohio, will not be changed, and it will remain associated with the Morgan Engineering Co., Memphis, Tenn., of which L. L. Hidinger is president.

Mr. Chambers has been associated with the organization, except for occasional interruption, since the parent company was organized in Memphis, 1909. He has been in charge of some of the major projects carried out by the company and at present is chief engineer of the Muskingum Watershed Conservancy District of Ohio. The preliminary work on this development which is now under construction was carried out by the company.

Mr. Bock's inactive connection with the company results from his present position of director of general engineering and geology for the Tennessee Valley Authority.

Work Starts on Three Bridges to Span Bonnet Carre Spillway

Construction work on the three railroad and one state highway bridges to span the Bonnet Carre spillway, near New Orleans, has been started. The embankment approaches for the Yazoo and Mississippi Valley railroad span were started in February. The contract for the north end embankment was let to the Walsh Construction Company, the south fill to the Gifford-Hill Company. Bids for the concrete piers were received by the railroad and are being tabulated. Work on the piers is scheduled to begin about May 15. Construction of the timber trestle will begin in June. The span itself will be 8,000 ft. long of single-track ballast deck type. The ballast deck trestle and steel work will be erected by the railroad's construction forces. Clearing of the right of way for the span has already been started.

The trestle of the Illinois Central Railroad will be about 12,000 ft. long within the spillway guide levees, with long earthwork embankment approaches to the levees. Work on the two approach embankments has been started by the construction forces of the railroad and the right of way for the span within the spillway proper is being cleared. The Illinois Central trestle will be of ballast deck type and carry two tracks. Bids for the span's concrete piers have been received, and construction work is scheduled to begin about May 15. The ballast deck trestle and steel work will be erected by the railroad's construction forces.

Plans for the Louisiana and Arkansas railroad bridge have been completed and construction work is scheduled to start soon. Improvement of approaches to the concrete bridge to be erected by the Louisiana Highway Commission has been started and work on the span itself will start shortly.

DETAILS OF PWA LOANS AND GRANTS FOR NON-FEDERAL WORK

Locality	Loan and Grant or Grant	Type	Amount
Shinnston, W. Va.	L. & G.	Water system	$48,000
Wayne, Okla.	L. & G.	Waterworks system	32,000
Grafton, Ohio	L. & G.	Waterworks system	20,000
Cass County, Tex.	L. & G.	School building	14,000
Golconda, Ill.	L. & G.	Waterworks system	66,000
Petersburg, W. Va.	L. & G.	Sewerage system	14,000
Little Rock, Ark.	L. & G.	Administrative building	68,000
Redfield, S. D.	L. & G.	School building	98,600
Hockley County, Tex.	G.	School building	12,000
Great Neck, N. Y.	L. & G.	Sewer system	705,000
Lexington, Nebr.	G.	Waterworks	14,000
Olton, Texas	L. & G.	Waterworks system	34,000
Sayre, Okla.	L. & G.	Waterworks system	40,000
Nelsonville City, Ohio	L. & G.	School buildings	5,000
New York, N. Y.	L. & G.	School buildings	2,268,500
Glen Allen, Ala.	G.	School building	2,900
Pasquotank, N. C.	L. & G.	School house	50,000
Normangee, Tex.	L. & G.	Waterworks system	32,000
Hannibal, Mo.	L. & G.	Highway bridge	526,000
Lydick, Ind.	L. & G.	School building	41,000
Grandview, Tex.	L. & G.	Waterworks system	9,000
Hinton, Okla.	L. & G.	Waterworks system	20,000
Grand Island, Nebr.	G.	Sewer system	57,000
New Berlin, N. Y.	L. & G.	School building	119,050
Collinsville, Ill.	G.	Sewer system	43,000
St. Edwards, Nebr.	L. & G.	Waterworks	5,000
Port Chester, N. Y.	L. & G.	Street repairs	65,000
Cold Spring, N. Y.	L. & G.	School building	370,000
Meredith, N. H.	L. & G.	Street repair	32,000
Randolph County, Ga.	L. & G.	School building	35,000
Eddyville, Nebr.	L. & G.	School Building	30,200
Union, N. C.	G.	School building	13,500
Columbia County, Ark.	L. & G.	School building	45,000
West Virginia	L. & G.	Faculty residences	41,000
Lexington, N. C.	L. & G.	Water supply	100,000
Pawtucket, R. I.	L. & G.	Trunk sewer	42,000
Pawtucket, R. I.	L. & G.	Trunk sewer	60,000
Beaver City, Nebr.	L. & G.	Waterworks	16,000
Marshall, Tex.	L. & G.	Waterworks	23,000
Wakenda, Mo.	G.	School building	1,000
Wahoo, Nebr.	L. & G.	School building	23,000
St. Bernard, Ohio	L. & G.	Streets	$50,000
West Plains, Mo.	G.	Sewage plant addition	4,900
Bismarck, N. D.	L. & G.	High school bldg.	308,700
Kirkwood, Mo.	G.	Sewer system extension	11,400
Sykesville, Pa.	L. & G.	Water supply main	50,000
Weekapaug, R. I.	L. & G.	Highway bridge	60,000
Nashville, Tenn.	L. & G.	Viaduct	193,000
Fairfax, Okla.	L. & G.	Waterworks	30,000
Valley City, N. D.	G.	Heating plant	17,000
Wilton, Conn.	L. & G.	School addition	60,000
State of Nebraska	G.	School building	1,300
Wetumka, Okla.	G.	School repairs	3,700
West Bradford, Penna.	L. & G.	School addition	14,000
Magnolia, Miss.	L. & G.	Waterworks	15,000
Grayson County, Tex.	G.	School addition	8,000
Fremont, Nebr.	G.	Street repairs	3,500
St. John, N. D.	L. & G.	School building	37,400
Irvington, Ky.	L. & G.	Waterworks system	46,000
Stockton, Ill.	L. & G.	School addition	23,300
Honea Path, S. C.	L. & G.	Waterworks	10,000
Nehawka, Nebr.	L. & G.	Waterworks	21,000
Sheridan County, Nebr.	G.	Highway bridges	5,000
Grenada, Miss.	L. & G.	Swimming pool	9,000
Clifford, N. D.	L. & G.	School building	43,500
Mott, N. D.	G.	Court House	26,000
Regent, N. D.	G.	Bridge	4,000
Livermore, Ky.	L. & G.	Waterworks	35,000
York, Nebr.	G.	Sewage plant	15,000
Mazomanie, Wis.	L. & G.	Municipal building	25,000
Franklin County, Ohio	L. & G.	School building	75,000
North Carolina	G.	School buses	23,000
West Norriton, Pa.	G.	Sewerage system	60,000
Stevenson, Ala.	L. & G.	Waterworks Imp.	20,000
Shaker Hgts., Ohio	G.	Streets	7,100
Lynchburg, S. C.	L. & G.	Waterworks system	31,000
Scotland County, Mo.	G.	School addition	4,500
Lexington, Ky.	L. & G.	Sewer extensions	155,000
Cleveland Hgts., Ohio	G.	Street repairs	7,000
Haverstraw, N. Y.	L. & G.	School building	690,000
University Hgts., Ohio	G.	Streets	1,900
Lloyd Harbor, N. Y.	L. & G.	School building	82,000
		Total	$7,527,950

Washington Notes

By Paul Wooton
Washington Correspondent

The Administration will probably ask for $1,500,000,000 for public works in the coming fiscal year, according to House majority leader Joseph W. Byrns, but Administrator Ickes expressed the opinion that this amount is also intended to cover other emergency expenditures. With reference to the proposal for joint financing of public works by RFC and PWA, Mr. Ickes announced his intention of suggesting that the RFC purchase municipal bonds now in PWA's portfolio, but l e explained that the proceeds would revert to the Treasury unless PWA is authorized by legislation to create a revolving fund.

An allotment of $250,000 has been made to the Bureau of Public Roads to cover supervision and inspection of road and street construction by states and counties with loans and grants in addition to the $400,000,000 road program. PWA inspection division will continue to handle the supervision and inspection of town and city street improvements. Loans and grants for such additional road and street work represents $50,646,000, and the total cost of such work is estimated at $92,000,000.

The Rivers and Harbors Committee of the House of Representatives has voted to report favorably the omnibus bill for rivers and harbors work, which carries an appropriation of $195,872,000. Of this total $43,795,000 has already been allotted by the PWA. The largest project included in the bill is for the improvement and the canalization of the Beaver and Mahoning Rivers at an estimated cost of $37,000,000.

The other major items included in the bill are:

Great Lakes-Hudson River waterway, New York, $27,000,000.

Inland waterway, Delaware River to Chesapeake Bay, $12,625,000.

Illinois waterway, $18,344,000.

New York Harbor, $3,750,000.

Delaware River, Philadelphia and Camden, $3,828,000 ($1,000,000 allotted by PWA).

Allegheny River, Pa., $3,042,000.

Keweenaw waterway, Michigan, $2,650,000.

Calumet harbor and river, Ill. and Ind., $4,540,000 ($3,058,000 allotted by PWA)

Indiana harbor, Ind., $1,820,000 ($897,000 allotted by PWA).

Buffalo harbor, N. Y., $1,863,000 ($709,000 allotted by PWA).

Black Rock harbor and Tonawanda harbor, N. Y., $1,044,000.

San Diego harbor, Calif., $1,800,000.

Hudson River channel, New York and New Jersey, $865,000 ($600,000 allotted by PWA).

San Joaquin River and Stockton Channel, Cal., $990,000.

Erie harbor, Pa., $337,000.

Monterey harbor, Calif., $240,000 ($224,000 allotted by PWA).

San Francisco harbor, $498,000 ($265,000 allotted by PWA).

Lower San Francisco Bay, $300,000.

A recommendation that the federal government undertake no further improvement of the Raritan River channel at this time has been filed with the Rivers and Harbors Committee of the House.

Brief News

BY A VOTE OF 32 TO 3 the Kentucky senate passed a house bill to provide for licensing all road, highway and bridge contractors in the state. The license fee for the first year would be $50, with a charge of $10 for renewals.

A NEW BUILDING CODE for Minneapolis, Minn., representing several years work on the part of a committee of the Civic and Commerce Association has been completed and presented to the city council for action.

IN THE FUTURE no bids submitted by outside contracting firms will be accepted by the city of Toronto until the city's fair wage officer has reported assurance that the rates of wages paid are just and fair.

THE AUSTIN, TEX., city council has decided to construct three public works projects without waiting for PWA money already allotted. No bond election will be held and the city will finance the immediate construction of: a 6,000,000-gal. capacity settling basin at the city filtration plant, $100,000; a nurses' home, $35,000 and a public market, $30,000.

THE MAKING OF TEST BORINGS at the site of the proposed flood control dam on the Tygart River, above Grafton, W. Va., has been begun. Recently the PWA allotted $12,000,000 to the Corps of Engineers for this project. It will furnish a large part of the storage required for flood control on the Monongahela River. Survey for the land required for the reservoir also is in progress.

THE COLORADO SUPREME COURT held that House Bill No. 6 which proposed to borrow $10,000,000 from the federal government for highway construction, for reducing unemployment, was unconstitutional. In its comment the court said that to permit evasions of the constitution would establish precedents, possibly the piling up of excessive public debt on future generations.

PRESIDENT RODRIGUEZ, of Mexico, has approved plans for the construction of a large irrigation dam on the Nazas River, near Torreon, Coahuila, an important cotton growing center. The dam and kindred works, including purchase of a large ranch to be used as an agricultural colony by 1,200 persons, will represent an investment of about $8,400,000.

SOCIETY CALENDAR

AMERICAN SOCIETY FOR TESTING MATERIALS, Atlantic City, N. J., June 25-29, 1934.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Vancouver, B. C., Canada, July 11-14.

AMERICAN WATER WORKS ASSOCIATION, annual convention, New York, June 4-8, 1934.

AMERICAN WELDING SOCIETY, annual meeting, New York, April 26.

INTERNATIONAL CITY MANAGERS' ASSOCIATION, annual conference, St. Louis, Oct. 15-17.

SMOKE PREVENTION ASSOCIATION, annual convention, June 19-22, Buffalo, N. Y.

NEW YORK SECTION, American Water Works Association, will hold its spring meeting at Binghamton, N. Y., April 19-20.

ILLINOIS SECTION, American Water Works Association, will hold its spring meeting at Peoria, Ill., April 18-19.

MARYLAND-DELAWARE WATER AND SEWERAGE ASSOCIATION will hold its eighth annual conference at Washington, D. C., May 3-4.

Personals

HENRY W. DURHAM is chief engineer of Parrish & Co., in charge of extensive municipal improvements at Barranquilla, Colombia, including paving, sewers and additions to the waterworks system.

THOMAS JACOBI, for several years with the bureau of reclamation in Denver, has gone to Marahano, Brazil, in the service of a public utility company.

S. J. BUCHANAN, formerly field representative of the committee on earth and foundations, American Society of Civil Engineers, is now in charge of the soils laboratory at the U. S. Waterways Experiment Station, Vicksburg, Miss.

JOHN S. LONGWELL has been named chief engineer and general manager of the East Bay Municipal Utility District, Oakland, Calif., following the resignation of Frank W. Hanna. Mr. Longwell has occupied the position of assistant chief engineer and assistant general manager of the district since 1929. Prior to that he had been division engineer during the five-year construction program. Previously he had been with the bureau of reclamation since 1910. R. C. KENNEDY has been named assistant chief engineer and assistant general manager, having previously held the position of chief designing engineer. He will retain direction over the work of design. J. D. DECOSTA, for several years sanitary engineer of the district, has been appointed engineer in charge of the distribution division, a function which was formerly part of the duties of the assistant chief engineer.

Obituary

GEORGE E. MCMULLEN, retired general contractor, New York, died in that city at the age of 53. He had been engaged in contracting prior to coming to New York in 1895, to become a partner in the Arthur McMullen Co., which had previously been founded by the brother of the late Arthur McMullen.

VICTOR S. PETTERSON, deputy city controller of Chicago since 1929, died April 4. He was a graduate of Columbia University, and spent several years in South America on railroad construction, including four years on the Panama Railroad. He had been in the Chicago controller's office since 1916, and the compilation of the city budget was one of his duties.

A. HOWELL VAN CLEVE, formerly a resident of Niagara Falls, New York, died April 2 at Lynn Haven, Fla., where he had lived in retirement for several years. Mr. Van Cleve was a graduate of Lehigh University, served as resident engineer for the Niagara Falls Power Co., was engineer for the Sizer Forge Co., Buffalo.

JAMES H. SULLIVAN, former commissioner of public works, Boston, Mass., and connected with the engineering department of the city for many years, died in that city April 4 at the age of 74. He began his service in the engineering department of Boston in 1888, spending several years on work in connection with the extension of the city's water system, later working in both sewerage and highway departments. He rose through various ranks, serving both as deputy superintendent of streets and divisional highway engineer. He was

appointed commissioner of public works in 1926, and retired in 1930. Mr. Sullivan was a past president of the Massachusetts Highway Association.

F. PAUL ANDERSON, dean of engineering, University of Kentucky, since 1917, died at Lexington, April 8, at the age of 67. Dean Anderson began his service at the university as professor of mechanical engineering in 1891. In 1894 he served on the international jury of awards at the St. Louis exposition, and for many years was engineer of tests for the Southern Railway Co. As director of the research laboratory of the American Society of Heating and Ventilating Engineers, he was particularly active in the subjects of heating, ventilating and air conditioning. In 1927 he served as president of this society. He was a graduate of Purdue University.

ARTHUR C. EATON, hydraulic engineer of the New England Power Company system since 1919, died at his home in Worcester, Mass., following a heart attack. He was born at Lunenberg, Mass., in 1883, and educated at the University of Vermont, which conferred the degree of doctor of engineering upon him in 1932 in recognition of his professional achievements. From 1908 to 1912 he was engaged in highway and canal work in connection with the New York State Water Supply Commission. In the latter year he entered the employ of the then Power Construction Company, which built the hydroelectric plants of the New England power system in the Shelburne Falls district on the Deerfield River, and was soon appointed assistant hydraulic engineer under the late A. A. Conger. He was the recipient of the Desmond Fitzgerald medal of the Boston Society of Civil Engineers for his paper in 1924 on the Harriman development.

CONSTRUCTION STATISTICS OF THE WEEK

ENGINEERING CONSTRUCTION awards this week are up 30 per cent to $25,418,000. State and municipal and private contracts are responsible for this gain since federal awards dropped back from $6,489,000 last week to $3,442,000 this week. State and municipal awards are up to $14,840,000 from $8,607,000 and private to $7,136,000 from $4,445,000 last week. This week is about 10 per cent ahead of the average week to date, $23,200,000.

Highway awards staged a comeback, $8,858,000, after running at or below $6 millions for four weeks. Waterworks at $1,067,000 are ahead of last eek; sewerage at $1,758,000 is slightly ahead; bridges at $1,982,000 are slightly down; and the earthwork, irrigation and waterway classification is down, $1,906,000 compared with over $3 millions last week. In the building group, public buildings are about the same as last week, $1,953,000, industrial buildings, at $1,690,000, slightly below and commercial buildings, at $2,000,000, well over last week's low of $300,000.

Large lettings this week include the Lawrenceburg distillery in Indiana, $500,000; highway awards by Montana, $1,131,000, by Texas, $692,000 and by Illinois, $1,008,000; sewage disposal plants at Rochester, N. Y., $500,000 and Perth Amboy, $759,000; and bridges by Texas, $600,000, and by Illinois, $525,000. In Wyoming the Bureau of Reclamation awarded earthwork and tunnel contract on Casper-Alcova project, $609,000. In Michigan the U. S. Engineers awarded dredging in Detroit River, $856,000. Large materials awards include cement for T V A, Knoxville, $661,000; rails, Chicago, Milwaukee and St. Paul Ry., $735,000, Boston and Maine R. R., $1,100,000 and Erie R. R., $1,500,000.

New capital this week totals $26,370,000 of which $27,500,000 is state and municipal bond sales and minus $1,430,000 represents the excess for the week of reductions in allotments and rescissions over reallotments by the Public Works Administration. This week's municipal bond sales are the highest in more than a year. The total is swelled by several large issues $12,000,000 emergency construction and $8,000,000 grade crossing elimination bonds by New York State, $3,350,000 auditorium bonds by Kansas City, Mo., and $1,058,000 bonds for waterworks, schools, streets and sewerage in New Bedford, Mass. The latter represents a direct transfer from P W A loan financing to private financing since this week's P W A allotment figures include a change for New Bedford from $1,449,000 loans and grants to $422,600 grants only. This one case releases $1,026,400 in PWA funds.

CONTRACTS

(Thousands of Dollars)

	Weekly Average Apr. 1933	Prev. 4 Weeks	Week Apr. 12 1934
Federal Government	$1,756	$4,213	$3,442
State and municipal	5,060	12,568	14,840
Total public ...	$6,817	$16,781	$18,282
Total private	5,531	4,092	7,136
Week's total	$12,348	$20,873	$25,418

Cumulative to date:
1933 ....$244,141 1934.....$348,005

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

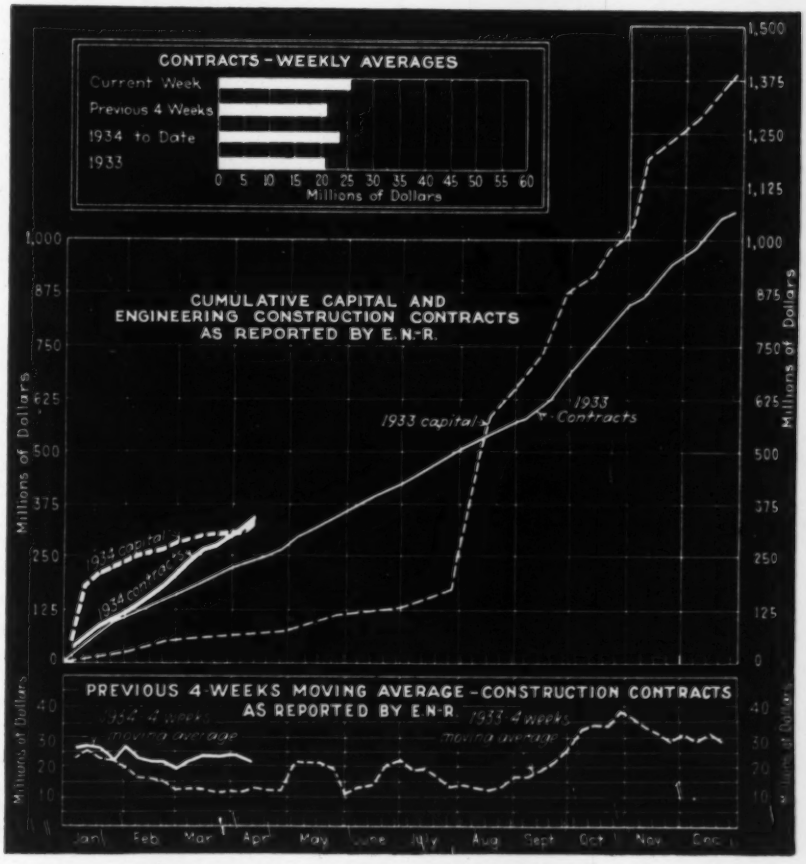
1934	Week Apr. 12	Cumulative
State and municipal ..	$27,500	$87,116
PWA allotments, S&M...	1,430	196,495
Corporate issues	...	10,595
PWA allotments, private	300	45,131
Total, Non-Federal....	$26,370	$339,337
PWA allotments Federal Constr.	40	48,142
Total new capital	$26,410	$387,479

Cumulative to date:
1933 .....$70,867 1934.....$339,337
Rescinded or reduced allotments (from 1933 PWA totals).....$43,323

Note: These figures include private bonds and stock sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities, including the special highway funds; PWA private loans, and allotments for Federal construction.

INDEX NUMBER

E.N.-R.-Cost		E.N.-R.-Volume	
April, 1934.....	195.86	March, 1934.....	108
March, 1934.....	194.04	February, 1934...	88
April, 1933.....	160.16	March, 1933.....	62
1933 (Average)...	170.18	1933 (Average)...	102
1932 (Average)...	156.97	1932 (Average)...	127
1931 (Average)...	181.35	1931 (Average)...	220
1913 (Average).....	100		



Construction Equipment and Materials

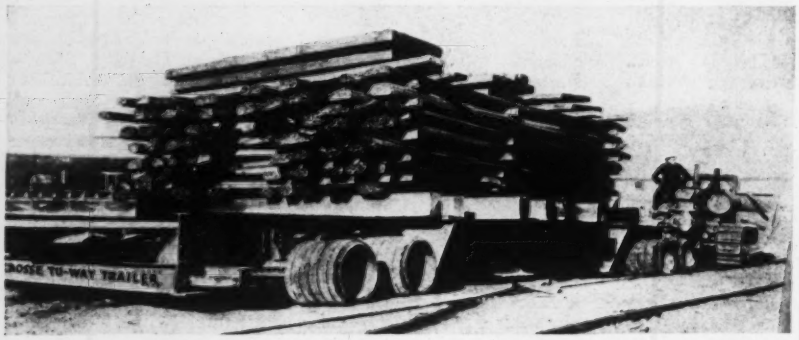
Huge Trailer for Boulder Dam Carries Load of 194 Tons

The largest trailer ever built, measuring 37 ft. 8 in. long and 22 ft. wide, has been built by the La Crosse Boiler Co., of La Crosse, Wis., for use in transporting the penstock pipe from the fabricating plant to Boulder Dam.

The frame of the trailer is of fabricated steel built up on two 33 in. beams. It is mounted on 16 solid-rubber-tired wheels, supported by eight axles. Each axle carries two wheels with two tires to the wheel, making 32 28x14 tires. Axles are of the tilting, oscillating type to care for road irregularities.

All 16 wheels are steered by hydraulic pressure. Air brakes of the internal expansion type are provided. Hauling may be done from either end and drawbars are provided.

A test of the unit, held near Boulder City, consisted of loading it with bundles of reinforcing rods aggregating 194 tons. The trailer itself weighs 41 tons.



Huge trailer for use at Boulder Dam

Remote Control for Voltage On Electric Welder

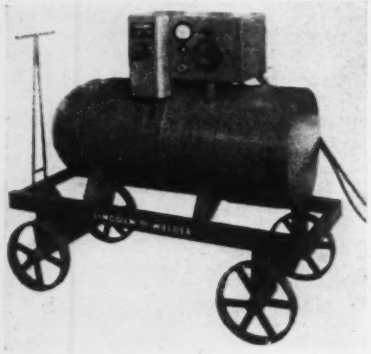
Higher quality welds and increased weld output are claimed for a new remote control device for arc welding machines announced by the Lincoln Electric Co., Cleveland, Ohio. No additional cables or other apparatus need be carried by the operator. In operation, the operator taps the electrode on the work several times and the voltage is automatically raised. A larger number of taps has the result of lowering the voltage.

The manufacturer states that high quality weld metal is assured with the new control device as there is no temptation on the part of the welder to use the original current setting rather than return to the machine to reset the controls.

The control mechanism is encased in a small box which may be quickly attached to the welder voltage control. No additional apparatus is necessary. The regular manual control may still be used, as desired.

"Lincontrol" is offered as optional equipment with the new Lincoln shield-arc welders. It may be purchased separately and installed on motor driven, belt driven or gasoline engine welders now in use.

Remote voltage control for arc welder



New Publications

OPERATORS HANDBOOK, TRUCKS AND BUSES. B. F. Goodrich Co., Akron, Ohio. 40 pages, 4x6¾. Information on tire performance.

PIPE JOINTS. Stanton Ironworks Co., Ltd., Nottingham, England. 20 pages, 8¼x11. A review of the standard types of cast-iron pipe joints in use in England.

GYPSTEEL PLANK. Structural Gypsum Corp., New York, N. Y. 20 pages, 8½x11. Describing a lightweight incombustible plank made of reinforced gypsum.

THE LOUIS ALLIS MESSENGER. The Louis Allis Co., Milwaukee, Wis. 24 pages, 8½x11. The first issue of a new magazine devoted to developments in the field of electric motors.

T-TRI-LOK BRIDGE FLOOR CONSTRUCTION. 8½x11. 46 pages. Carnegie Steel Co., Pittsburgh, Pa. Second edition. Illustrates applications of this steel specialty and provides engineering data for use in design.

THERMIT WELDING. Industry's Master Maintenance Tool. Metal & Thermit Corp., 120 Broadway, New York, N. Y. Describes thermit welding and alumino-thermic process, with particular attention to track work.

FERMANGO MAGNETIC INSPECTION EQUIPMENT. Catalog No. 2. 9x12. 20 pages. The Ferrous Magnetic Corp., 110 Washington St., New York, N. Y. Describes and illustrates equipment for inspecting magnetically wire, rods and strip steel, and welds.

USS STAINLESS AND HEAT RESISTING STEELS. Subsidiary Mfg. Companies of the United States Steel Corp., Pittsburgh, Pa. 48 pages, 8½x11. A treatise on stainless steels prepared under the direction of the Committee on Stainless and Heat Resisting Steels.

New Equipment in Brief

Road Roller. The Hercules Co., Marion, Ohio, announce their Hercules model 100, 10-ton three wheel road roller is now available with hydraulic power steering control. A cast-steel steering arm is mounted directly on the top of the king post, connected to which are the hydraulic piston and cylinder.

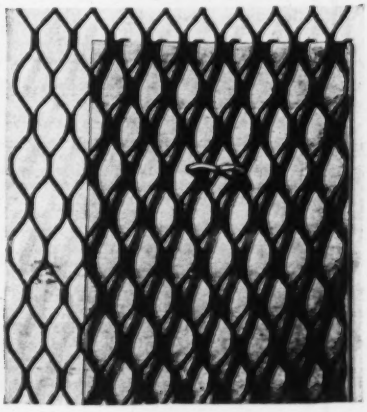
Air Compressor. The Westinghouse Traction Brake Co., Pittsburgh, Pa., has developed a line of new air compressors ranging in size from 4 to 31 cu.ft. displacement, against pressures up to 200 lb. These machines are of the two-cylinder, compound, air-cooled type. Development of excessive friction is prevented by ball bearing mounting of the crankshaft. The unloading feature is interlocked with the oiling system to prevent the compressor delivering air when the oil supply is depleted.

Industrial Tractor. International Harvester Co., Chicago, Ill., has announced the new McCormick-Deering I-12 industrial tractor. It has a maximum engine power of 21 hp. It is 96 in. long overall, 50 in. wide and 52 in. high over the steering wheel, and its turning radius is 103 in. It has a speed range from a low of 2½ miles an hour up to 10¼ miles an hour. Brakes of internal-expanding type are operated by foot pedal. It is provided with pneumatic tires.

Board-Backed Metal Lath For Ceilings and Partitions

A new building material called Lathtex, for use in ceiling and partition construction, has been introduced by the Penn Metal Co., Parkersburg, W. Va. Lathtex consists of metal lath with a kraft board backing. This board backing is attached to the metal lath with a special metal clip. There is enough spring in the board between fastenings, the maker states, to permit a free flow of mortar on the back side of the lath with the Kraft board as a form, producing a reinforced slab of plaster. The metal lath is thoroughly embedded in the plaster.

Lathtex also provides heat and sound insulation.

The manufacturer lists three uses for the new product: for suspended ceilings, laced to channel irons; for nailing to wooden studs in ceiling or partition construction; for sheathing in stucco work.

Penn Metal Co.'s Lathtex